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Citrus 2-8446

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NOTE—*Volume 20 of The Petroleum Engineer ran only three numbers, from October to December. In order to begin our four magazines with a new volume, January number began Volume 21. Index for Volume 20 will be in March issue.*

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What Is True Conservation?

"Once true conservation practices are established and enforced, all market demand or proration factors should be abolished." This startling statement is taken from the final report of the Oil Subcommittee of the Senate Small Business (Wherry) Committee filed last month with the Senate of the United States.

To establish and enforce true conservation practice it is necessary to regulate the flow of oil from a field or reservoir. How is such regulation to be accomplished if not by some method of proration?

Under present modern field practice, proration factors are tied in with the efficient rate of production. Proration regulations in Texas, the state having the largest oil production in the nation, are designed to prevent a rate of production that will result in underground waste.

When the demand for oil exceeds the supply, proration as a true conservation measure may be, and usually is, erroneously construed as a means of keeping oil off the market in order to hold up the price. When the supply exceeds the demand, however, what is true conservation practice?

Should crude oil be produced beyond storage capacity? If it be, economic waste of a valuable natural resource occurs on a grand scale. Two distinct kinds of waste are involved, physical waste and economic waste.

Physical waste occurs because of losses by evaporation and weathering of the crude oil and results in losses of valuable light constituents contained in the oil. This is a form of above ground waste that can lead to tremendous losses.

Economic waste occurs because of low prices if supply outruns demand on any sizeable scale. This leads to inefficient utilization of oil and its products, a form of economic waste that can result ultimately in serious losses to the nation, the public, and the industry.

True conservation practice, then, so far as it relates to crude oil production, must take into account the law of supply and demand.

Unless the demand for crude oil is taken into consideration, there can be no *true conservation* of crude oil reserves.

What of available reserves? It has been suggested that a daily reserve capacity of available oil of a million barrels should be built up in the United Sates. Railroad Commissioner Thompson of Texas pointed to the fact that in 1941 at the outbreak of World War II, the United States had this amount of available capacity. He said that such a margin is needed for national security.

He further stated that "regulating production to market demand is the only means by which the industry can build up a margin between its maximum efficient producing capacity and current production."

As for state conservation laws he said that these "have been criticized because they provide for limiting production to market demand, and it is assumed that such laws result in fixing prices. The facts are entirely different. Experience has demonstrated that when a state permits oil to be produced in an excess of demand, physical waste as well as economic waste results. If new fields absorb too much of the market, the older wells can not compete and have to be abandoned prematurely."

His apt statement that "The only oil reserve worthwhile is one ready at the turn of the valve" is one that may well be pondered by authorities in Washington looking to the national welfare in the matter of crude oil reserves.—K.C.S.

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Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—Interior Department's drum beaters are again thundering about "oil shortage" as they press Congress for the millions needed to start building commercial-size plants to make synthetic fuels.

Whenever the occasion offers, Interior officials go into their routine. First, there is the pessimistic statement on the U. S. oil outlook; then the argument that synthetic fuel is the only answer. Twice in one week recently, Secretary Krug took this position on Capitol Hill.

▸ **Krug Takes Long Look.** Before the Senate Interior Affairs Committee, Krug said: "In the long run, we shall have to depend in large part on synthetic sources for our liquid fuels."

At the same time, Krug was presenting his synthetic fuels report, which took a dim view of domestic oil reserves. Without a pronounced increase in the number of major oil discoveries, according to Krug's report, "the prospects for increasing our present productive level are not encouraging."

There is danger, Krug added, that the U. S. will depend on petroleum until the supply problem becomes critical. That is why Krug supports the Wolverton-McCarran bill for government loans for private synthetic fuel plants, or for building government plants if industry won't.

▸ **Warns on Imports.** Any gap between domestic productive capacity and demand could be filled with imported oil—but it would be dangerous, militarywise, to rely on foreign sources, Krug declared. In time of war, Middle East oil could be cut off while moving oil by tanker from South America would be susceptible to interference.

Krug's warning against the U. S. becoming dependent on foreign oil sounded like arguments of the Independent Petroleum Association of America fighting to stem the flood of imports. But the parallel ends there. The IPAA believes that domestic producers can now meet all demands.

▸ **IPAA Begins to Fight.** Led by Russell Brown, general counsel, the IPAA has taken off the gloves in its fight against imports. Brown's salvoes of statements bristle with charges of a "combine of importers" attempting to "destroy" domestic oil producers. He is carrying the battle to Capitol Hill almost daily. Recently, he went from one congressional hearing to another, urging that legislation be enacted limiting imports. IPAA opposed extension of the reciprocal trade agreements law under which the 21c tax on oil imports was halved. And now the producers organization is studying whether the Anti-Dumping Act of 1921 can be invoked in the present oil import situation.

▸ **Cites NPC Policy.** The IPAA is making capital out of the National Petroleum Council's policy report—adopted recently without a dissenting vote—including the declaration that imports should only supplement domestic production in meeting our national requirements. Question is raised whether this import policy is being followed, with over 600,000 bbl a day of foreign oil coming in and displacing several hundred thousand barrels of domestic production, judging from allowable cutbacks.

▸ **Military's Views.** Defense Secretary Forrestal, when asked by newspapermen whether the military preferred Millde East or Latin American oil development, replied that Midle East oil was more improtant from the standpoint of European recovery than the military standpoint, then went on to add, "but the military, as such, does not have a preference as between Middle East and Latin American oil development."

▸ **First Oil Probes.** Congress has received its first proposals for oil investigations. Senator Langer (R, North Dakota) wants to look into how American companies obtain foreign oil concessions. Recent cuts in Penn Grade crude oil prices prompted Congressman Secrest (D, Ohio) to ask for an investigation to determine whether any antitrust law violations were involved and why consumer prices were not reduced, too.

A showdown is nearing on the tidelands issue. Before the Senate Interior Affairs Committee, headed by Senator O'Mahoney (D, Wyoming), are pending the states rights quitclaim bill and the Truman Administration's tidelands oil control bill. O'Mahoney sides with Truman on the tidelands issue but he may make some changes in the federal bill. *A compromise probably lies ahead, at the end of a hard fight.*

▸ **Divorcement Bills.** Senator Gillette (D, Iowa) has put in bills to divorce marketing, pipe lines, tankers, and barges from oil companies operating in other branches but it is not expected that they will be pushed this session. Gillette's bills show the fine hand of Paul Hadlick, counsel for the National Oil Marketers Association, which has advocated divorcement for over ten years. (Hadlick helped return Gillette to the Senate last fall.)

It was not surprising, therefore, when the Senate Small Business (Wherry) Committee recommended pipe line divorcement and a study of tank car and tanker divorcement—Hadlick, oil counsel for Wherry's committee, wrote most of the committee report.

▸ **Oil Compact Hit.** Another recommendation in the Wherry Committee's report was that Congress study whether its approval of the Interstate Oil Compact should be rescinded or modified. Activities of the Compact's economics advisory committee, which makes periodic forecasts of oil demand and required supply, were criticized. By coincidence, the Compact Commission was already considering protests of some independent producers against continuance of this advisory committee.

▸ **Steel Needs Studied.** Subcommittees of the National Petroleum Council's steel committee are re-examining supply, requirements, and distribution of steel products in all branches of the petroleum industry. At a recent meeting of the full committee, the concensus was that the steel situation, generally, had improved although there were some operators still having difficulties. Early in March, the committee will meet to study these subcommittee reports and decide what should be their recommendation regarding voluntary oil-steel allocation programs to increase production and eliminate maldistribution. Congress has approved such agreements until September 30.

▸ **TEL Stockpiling.** Plans for stockpiling scarce materials needed in event of war, now being finalized, may include building up a reserve supply of tetraethyl lead. The military has been working also on plans for stockpiling key products, and recently indicated interest in a voluntary steel allocation program for tankage, which may mean they are ready to start on this, provided they can scrape up enough funds for both storage and products.

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HIGHLIGHTS in Oildom

Situation Sensitive. Supply and prices are in a state of supersensitive response to the general business situation. Strong reason for this touchiness is that the petroleum industry is being baited by numerous proposals of control and taxation.

A Senate committee demanded an investigation of the Interstate Oil Compact, which it accused of controlling oil production to market demand or below. A Texas legislature committee proposes to raise $55,000,000 more income from tax increases on natural gas, sulphur, and oil. Indiana House of Representatives is considering a bill to increase the state gasoline tax from 4 to 6 cents for an estimated increased revenue of $17,000,000. Colorado wants a 25 cents a barrel levy on crude oil.

It is no great surprise to any one that Creole reduced oil production and prices in Venezuela; that Imperial raised prices in Canada.

Tidelands Tussle. Dispute over tidelands ownership brought several new proposals in the last month. The Texas legislature wants an amendment to the federal constitution that will recognize that title to the offshore areas.

In a speech before the CIO auto workers Harold L. Ickes, proponent of the federal claims, sought popular support by suggesting the U. S. government use proceeds of tideland oil reserves for education. Senator O'Mahoney (Dem. Wyo.) suggested there is room for compromise with states and federal governments sharing in oil royalties.

France Pays Premium for Oil. France had to reimburse ECA $120,000 representing premium payments on crude oil purchased by France under ERP for U. S. suppliers. Walter J. Levy, acting chief of petroleum branch at ECA, said the regular market price might be forced up as a result of premium prices being paid on transactions for which the U. S. footed the bill.

To Push Synthetic Program. The federal administration is preparing to push for congressional approval of a synthetic fuels development program expected to involve an expenditure of well in excess of the $450,000,000 unsuccessfully requested for last year.

Just how much higher the figure will go this year is not yet known, but officials of the Interior Department, where a new measure is being rushed to completion, say it will be substantially above the former one.

Colored Gasoline. Kentucky became the fifth state to require that gasoline for farm use be colored to halt violations of the gasoline tax law. Farmers are refunded the tax on gasoline for farm tractors and machinery but must not use it in their automobiles or farm trucks. Farm-use gasoline in Kentucky must now be colored purple.

Research Holds Its Own. There is a hint of greater research effort in Shell's announcement that $24,000,000 is earmarked for this purpose in 1949. The sum will finance worldwide petroleum research for the Shell companies in all phases of operations. Aviation and agriculture are particularly active and important research fronts, stated H. S. M. Burns, Shell Oil Company president. Broad basic research programs will receive a substantial part of the large budget.

Oil Industry Leads in Research. "Out of every research dollar being spent by private industry," said Richard J. Lund, head of the engineering economics division at Battelle Memorial Institute, in a speech before the Cleveland Petroleum Club, "the oil industry is spending 25 cents on petroleum research."

Lund told the members of the Cleveland Petroleum Club that the oil industry has been the leader in scientific industrial research since the days of World War I. He cited figures from Standard Oil Development Company, which indicate that this investment in research has paid off in profits. The leading oil company has earned over $15 on every dollar spent in research. For every dollar spent on research they have saved $3.72 in royalty payments; $8.62 in improvements in established processes or old products; and gained $2.07 in new profits from new products.

Argentina to get U. S. Oil Equipment. Dr. Jeronimo Remorino, Argentine Ambassador to Washington, said that Argentina had succeeded in getting priorities to buy in the United States $20,000,000 worth of equipment for oil exploration and exploitation, according to a U. P. report.

Potential Oil Customers. The petroleum industry has little time to rest, even after the heroic job of meeting demand in 1948. The Oil-Heat Institute of America forecasts oil burner installations 26 per cent higher in 1949 than last year. The Canadian oil industry will have a big new customer when the Canadian Pacific converts 100 steam locomotives from coal to oil-burning.

Bureau of Mines History Draws Comment

The articles on the Petroleum and Natural Gas Division of the U. S. Bureau of Mines by Ernestine Adams now running in The Petroleum Engineer have received wide comment in the daily press. The chart showing 73 federal agencies concerned with the oil industry drew considerable attention.

In its review of the series the Bartlesville (Okla.) Sunday Examiner states that the subject is approached with a refreshing, nontechnical viewpoint seldom experienced in dealing with this type of material.

The newspaper reports: "The author has treated her subject without fear or favor and although quite willing to give praise where praise is due, she has been forthright in pointing out instances where the division has made mistakes and where its effectiveness can be improved."

The third article of the series begins on Page A-43.

Lease Changes. The Interior Department has liberalized the regulations under which oil and gas operators must decide whether they want to bring their leases of federal land under terms of the federal leasing law as amended in 1946. Lessees were required to indicate their preference between this law and the old federal mineral leasing by last December 1, but new regulations now permit them to file that notice at any time up to the expiration of a lease.

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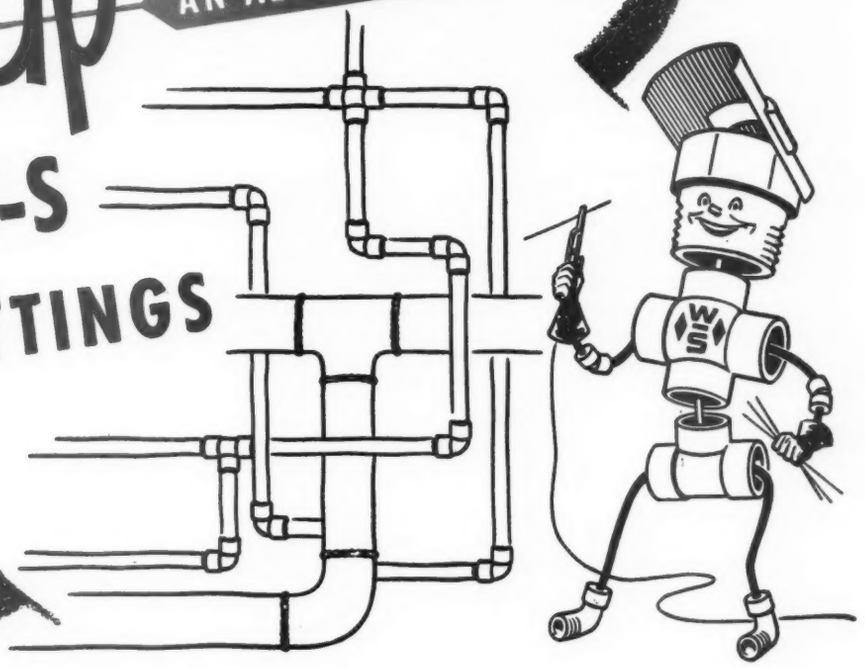

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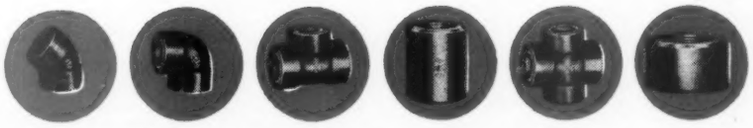

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National Petroleum Situation

Demand Drops Sharply. Mild winter weather during January had the effect of sharply reducing consumption of all grades of fuel oil. As a result, stocks have become burdensome in most distribution centers and surplus supplies have backed up into the Mid-Continent refining centers. Studies indicate a drop in fuel oil consumption in January to about 2,700,000 bbl daily, against last year's peak of 3,009,000 bbl daily. Stocks of all fuel oils are now about 74 per cent greater than a year ago and prices are being reduced over a wide front.

Price Cuts Spreading. Major marketing companies in the Northeast have announced further reductions in fuel oil prices and these are reflected in widespread reductions by refiners in several major areas. Excessive stocks of heavy fuel and greater than needed supplies of distillates are having a depressing effect upon both crude oil and product prices. Pennsylvania crudes have been reduced to $4 a bbl; California heavy crudes were reduced 25 cents by 4 major purchasers; medium and light oils are off 15 cents; Mexican heavy oil prices were cut 25 cents on January 19; prices of heavy crude oil in Venezuela were reduced 5 to 20 cents per bbl by Creole. Pessimism over the industry's general price outlook is engendered by a general world surplus of oil and a lack of storage facilities for expanded supplies.

Production Curtailment. Cut-back in Texas crude production in January amounted to about 178,000 bbl daily. California crude output was 14,000 bbl under December. Burdensome inventories of refined products brought about a reduction in refinery crude runs in January amounting to about 83,000 bbl daily. Further reductions in runs were reported at the close of January and indicated cut-backs averaging about 187,000 bbl below the December rate. The supply of all oils was about 113,000 bbl daily below the December rate, although the total supply was 6 per cent greater than a year ago.

Motor Fuel Ample. Stocks of motor fuel on February 1 were 18,477,000 bbl greater than a year ago and January production was nearly 9,000,000 bbl above last year. Supplies of this product will be augmented further by higher yields, for refiners must necessarily reduce the output of fuel oils to relieve the storage situation. Prospects are that summer gasoline demand will be greater than ever, but supplies will be more than ample to meet peak requirements.

Comparative Statistics, January, 1949

*All figures are computed on a Bureau of Mines' Basis**

	Jan. 1949℗	Dec. 1948℗	Jan. 1948	This year to date	Last year to date	Per cent change
Wells drilling	5,040	5,070	4,500	5,040	4,500	+12
Total wells drilled	3,338	3,507	3,027	3,338	3,027	+11
Development wells	2,645	2,763	2,305	2,645	2,305	+15
Oil	1,842	1,907	1,640	1,842	1,640	+14
Gas	217	236	207	217	207	+ 5
Dry	586	620	458	586	458	+28
Per cent dry	22.8	22.4	19.9	22.8	19.9	+ 2.9
Service wells	133	171	218	133	218	−39
Wildcat wells	560	573	504	560	504	+11
Oil	81	85	60	81	60	+35
Gas	10	15	19	10	19	−47
Dry	469	473	425	469	425	+10
Per cent dry	83.7	82.5	84.3	83.7	84.3	− 0.6
Crude supply*	183,745	188,700	172,208	183,745	172,208	+ 6
Daily average	5,927	6,087	5,555	5,927	5,555	
Crude demand‡	179,395	184,200	173,020	179,395	173,020	+ 3
Daily average	5,787	5,942	5,600	5,787	5,600	
Crude stocks	256,300	251,950	229,842	256,300	229,842	+11
Days supply	44	42	41	44	41	
Natural gasoline production	12,500	12,470	11,997	12,500	11,997	+ 5
Daily average	403	402	387	403	387	
Motor fuel production	82,780	80,500	73,812	82,780	73,812	+12
Daily average	2,670	2,597	2,381	2,670	2,381	
Gasoline yield, per cent	39.6	40.3	38.9	39.6	38.9	+ 0.7
Motor fuel demand‡	67,905	73,500	63,623	67,905	63,623	+ 6
Daily average	2,190	2,371	2,053	2,190	2,053	
Motor fuel stocks	115,090	100,140	97,613	115,090	97,613	+18
Days supply	52	42	47	52	47	
Fuel oil production	72,180	74,450	73,145	72,180	73,145	− 1
Daily average	2,328	2,402	2,360	2,328	2,360	
Fuel oil demand‡	83,375	87,930	93,282	83,375	93,282	−11
Daily average	2,700	2,836	3,009	2,700	3,009	
Fuel oil stocks	149,450	153,655	85,672	149,450	85,672	+74
Days supply	57	54	28	57	28	
Refinery still runs	174,210	176,800	165,796	174,210	165,796	+ 5
Daily average	5,620	5,703	5,348	5,620	5,348	
All refined stocks	366,840	352,370	260,929	366,840	260,929	+41
Days supply	62	55	41	62	41	

Supply and Demand—All Oils

	Jan. 1949℗	Dec. 1948℗	Jan. 1948	This year to date	Last year to date	Per cent change
Total supply, all oils	201,923	205,400	189,734	201,923	189,734	+ 6
Daily average	6,513	6,626	6,120	6,513	6,120	
Total demand‡, all oils	183,103	203,330	199,763	183,103	199,763	− 8
Daily average	5,907	6,559	6,444	5,907	6,444	
Change in stocks (total)	+18,820	+2,070	−10,029	+18,820	−10,029	

Current Crude Oil Prices

U. S. Average	$2.57	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.63	Mississippi	2.42
Kansas	2.62	Illinois	2.76
		Other states	3.00

Basic crude prices:

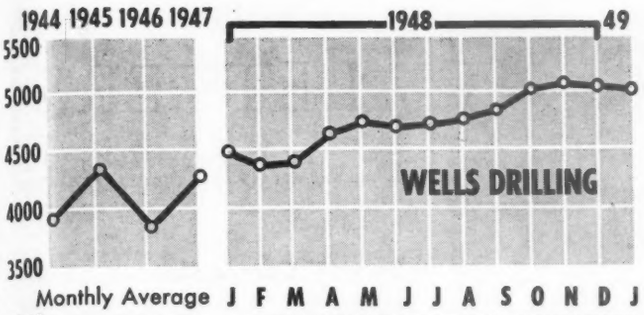
Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.86
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.41
Pennsylvania, Bradford	4.00

Drilling and Production Statistics by States

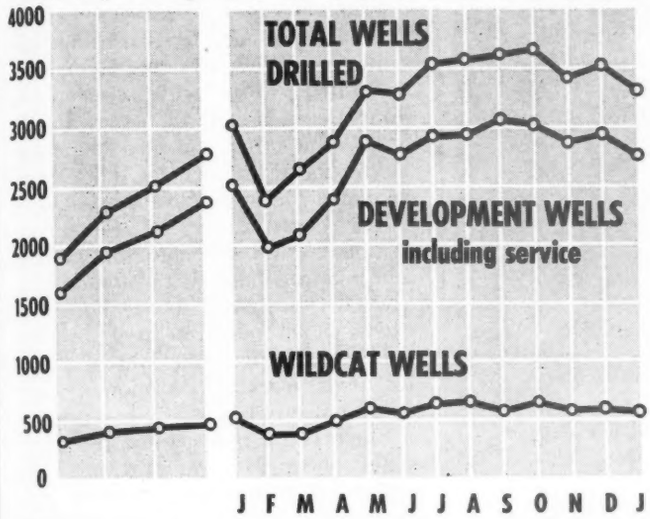
	Jan. 1949℗	Dec. 1948℗	Jan. 1948—	This year to date	Last year to date	Per cent change
Wells drilled (excl service)	3,205	3,336	2,809	3,205	2,809	+ 14
Arkansas	4	32	35	4	35	− 89
California	267	238	216	267	216	+ 23
Illinois	184	231	173	184	173	+ 6
Kansas	235	303	244	235	244	− 4
Louisiana	215	186	144	215	144	+ 49
Mississippi	29	38	35	29	35	− 17
New Mexico	41	58	60	41	60	− 32
Oklahoma	347	380	334	347	334	+ 4
Texas	1,231	1,140	892	1,231	892	+ 38
Other states	652	730	676	652	676	− 4
Wildcats drilled (incl above)	560	573	504	560	504	+ 11
Arkansas	2	11	11	2	11	− 82
California	53	43	26	53	26	+102
Illinois	34	46	28	34	28	+ 21
Kansas	44	34	35	44	35	+ 25
Louisiana	19	37	16	19	16	+ 20
Mississippi	12	14	9	12	9	+ 33
New Mexico	15	11	3	15	3	+400
Oklahoma	73	62	84	73	84	− 13
Texas	234	219	222	234	222	+ 5
Other states	74	96	70	74	70	+ 6
Daily crude production	5,485	5,687	5,283	5,485	5,283	+ 4
Arkansas	91	86	83	91	83	+ 9
California	946	960	931	946	931	+ 1
Illinois	181	180	172	181	172	+ 12
Kansas	305	305	289	305	289	+ 5
Louisiana	525	511	470	525	470	+ 12
Mississippi	120	130	114	120	114	+ 7
New Mexico	135	134	124	135	124	+ 7
Oklahoma	442	444	391	442	391	+ 13
Texas	2,363	2,541	2,353	2,363	2,353	0
Wyoming	135	149	141	135	141	− 4
Other states	242	247	215	242	215	+ 12

*Unless otherwise stated all figures represent thousands of barrels.
‡Total demand, including exports.
℗–Preliminary.
*Includes domestic production and imports.
¶Revised.

Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.



Monthly Average J F M A M J J A S O N D J



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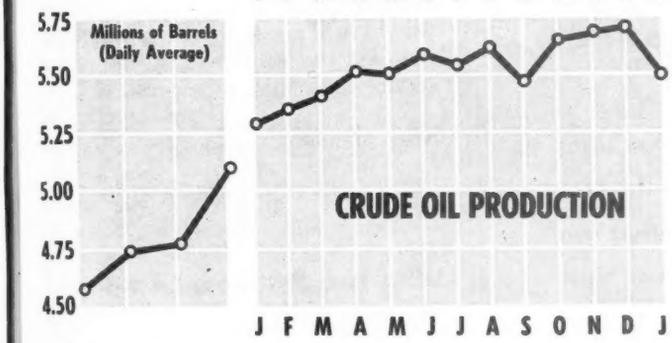

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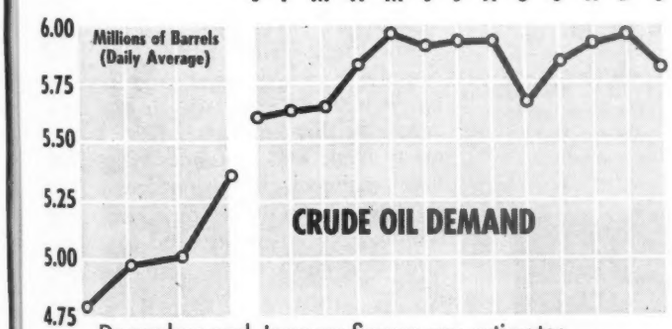
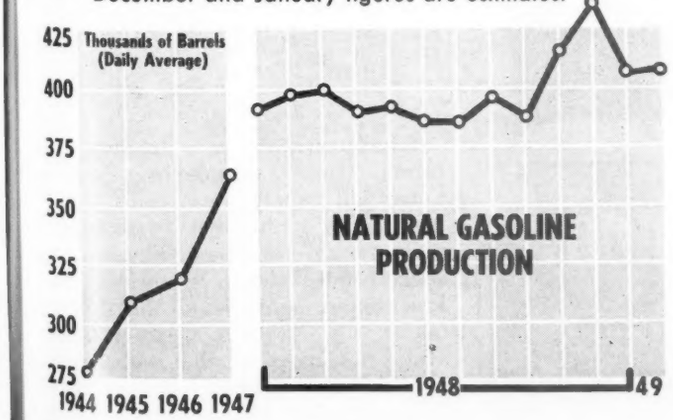
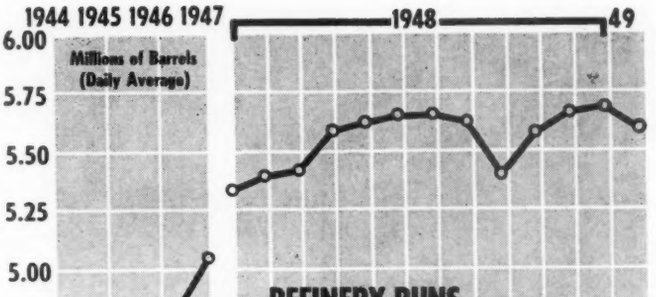


December and January figures are estimates.





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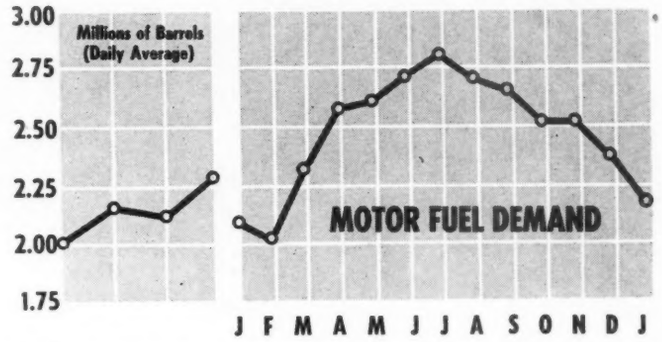

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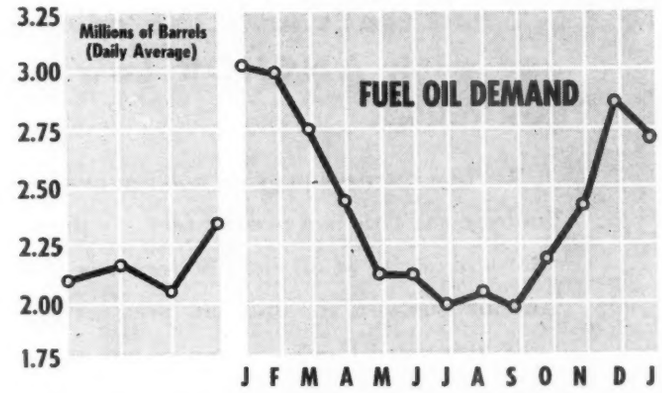

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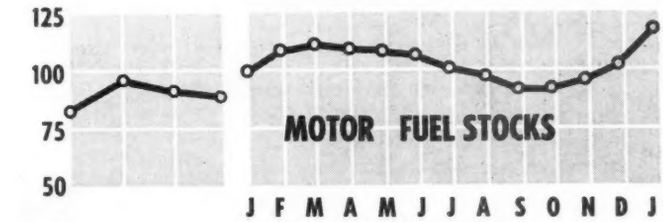

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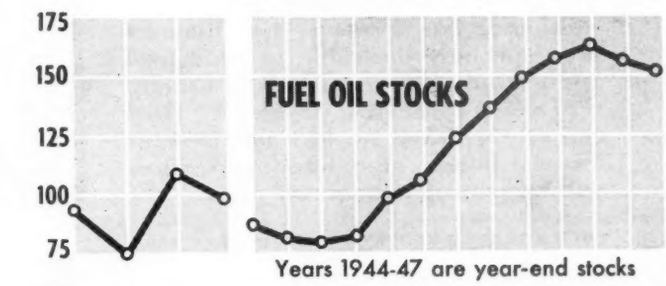
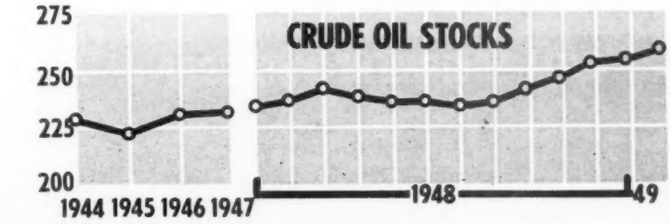


Years 1944-47 are year-end stocks



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LETTERS
to the Editors

Service Companies

To The Petroleum Engineer:

I have just completed reading your editorial, "Well Servicing Companies and Lifting Costs" which appeared in your December, 1948, issue. This is a splendid thing you have done and before the reaction fades, I hasten to acquaint you with our appreciation.

The contributions of the service companies too often go unremarked and unappreciated, with little thought given by the trade to the numerous extras which are given freely by service company personnel out of a love for their work which money alone could not purchase.

Since you already know from personal observation how deeply this philosophy of helpful service permeates the Lane-Wells organization, you have a measure of our appreciation for the kind words said about service companies in general.

Jas. D. Hughes,
Sales Manager,
Lane-Wells Company,
Los Angeles, California.

Who Is a Petroleum Engineer?

To The Petroleum Engineer:

I read your January editorial, "How Engineering Affects Crude Oil Supply," with interest and heartily agree with its contents. In my experience in this business I have known many men, who, without being graduate engineers or even having an engineering education, have contributed more toward good sound engineering than many men with degrees.

Harold Decker,
Vice President
Pan American Production Company,
Houston, Texas.

To The Petroleum Engineer:

I have reviewed your January editorial, "How Engineering Affects Crude Oil Supply," and feel that the material is both timely and appropriate. I am compelled, however, to suggest one revision. In my position, I, of course, cannot admit that a roustabout is a petroleum engineer; however, I do agree with what is obviously your thought, and that is that practice of engineering in varying degrees is

Letters—Continued

not confined to the work of the graduate petroleum engineer.

W. L. Ducker,
Chairman of Department
of Petroleum Engineering,
Texas Technological College,
Lubbock, Texas.

Editor's note: *W. L. Ducker would substitute "The man contributing engineering skill to this industry . . ." for "A petroleum engineer . . ." at the beginning of the fourth paragraph of the editorial. This substitution would be technically correct.*

To The Petroleum Engineer:

You did a nice job in your January editorial, "How Engineering Affects Crude Oil Supply." The topic is timely, and well handled—and I agree with your inclusion of those that did not have the opportunity to obtain a formal degree in some institution—other than the "school of hard-knocks," I mean. The latter is a pretty good institution in itself.

J. E. Elliott,
Consulting Engineer,
Austin, Texas.

Wyoming Again

To The Petroleum Engineer:

The factual information we received was the best I have ever read on the Wyoming oil and gas industry. Especially, the article by Horace D. Thomas on Geology and Petroleum Resources of Wyoming that appeared in your November 1948 issue. I also was very much interested in the Wyoming oil map that also appeared in that issue.

We have read lots about Wyoming in other magazines but none compares with these articles.

P. Fred Fox,
New York City.

To The Petroleum Engineer:

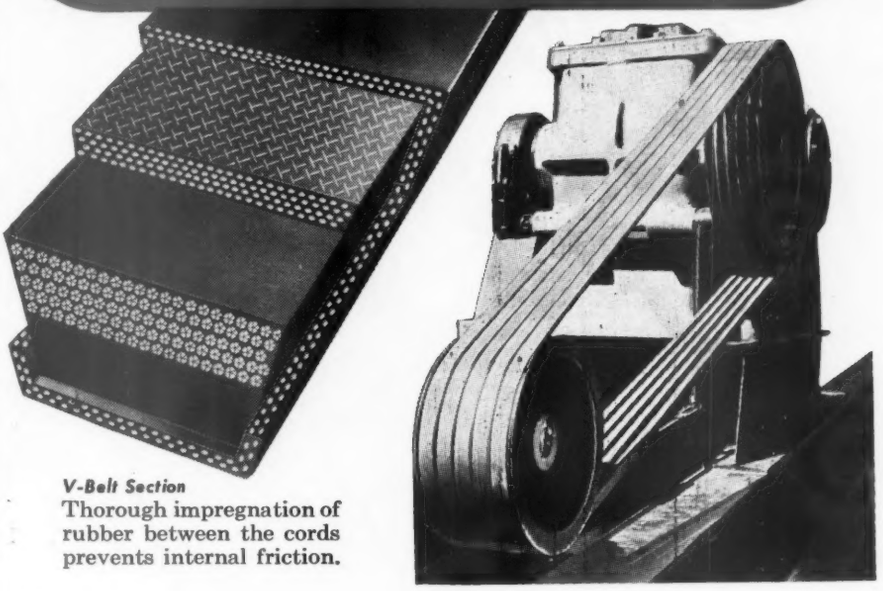
Is my face red. Temperatures central Wyoming for past three weeks from zero to 45° below. Rigs snowed in with no immediate prospect of relief. Our Bolton well in the sand for past three weeks, holding with 12-pound mud, 45 viscosity. Had to rescue crew through National Guard with Weasel; probably won't see location again for another two weeks.

I think you are nice not to have twitted me about our 'banana belt.' Of course this is 'very unusual.'

Geo. W. Jarvis,
Casper, Wyoming.

Editor's note: *From California and Texas and the states between comes the chorus to Mr. Jarvis, "Very, very unusual weather."*

Specify Thermoid



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MEETINGS

Feb. 28.-Mar. 4—ASTM, spring meeting, Hotel Edgewater Beach, Chicago, Illinois.

Mar. 6-10—American Institute of Chemical Engineers, Los Angeles, California.

Mar. 9—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.

Mar. 9-10-11—API, Southwestern District meeting, Galvez Hotel, Galveston, Texas.

Mar. 14-17—AAPG, Soc. of Exploration Geophysicists, and Soc. of Economic Paleontologists and Mineralogists, annual meeting, Jefferson Hotel, St. Louis, Mo.

Mar. 14-17—Chicago Technical Societies Council, production show, Hotel Stevens, Chicago.

Mar. 17-18—Oklahoma Utilities Assn, Hotel Tulsa, Tulsa, Oklahoma.

Mar. 23-25—API, Mid-Continent District meeting, Mayo Hotel, Tulsa, Oklahoma.

Mar. 27-April 1—ACS, spring meeting, San Francisco, California.

Mar. 28-30—Western Petroleum Refiners Assn, annual meeting, Plaza Hotel, San Antonio, Texas.

Mar. 28-30—SAE, Transportation meeting, Statler Hotel, Cleveland, Ohio.

Apr. 4-7—API, mid-year meeting, Shamrock Hotel, Houston.

Apr. 11-12—AIEE, Statler Hotel, Buffalo, New York.

Apr. 11-13—American Society of Lubrication Engineers, annual meeting, Hotel Statler, New York.

Apr. 11-13—Mid-West Gas Association, 44th annual convention, Hotel Ford, Des Moines, Iowa.

Apr. 11-14—National Assn of Corrosion Engineers, Netherlands Plaza Hotel, Cincinnati, Ohio.

Apr. 11-15—Western Metal Congress and Exposition, Shrine Auditorium, Los Angeles, California.

Apr. 12-14—Southwestern Gas Measurement Short Course, O.U., Norman, Okla.

Apr. 12-14—National Petroleum Assn, Hotel Cleveland, Cleveland, Ohio.

Apr. 13—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.

Apr. 13-14-15—National Petroleum Assn, Hotel Cleveland, Cleveland, Ohio.

Apr. 18-20—Mid-West Power Conference, Hotel Sherman, Chicago, Illinois.

Apr. 20-22—Natural Gas Assn, annual meeting, Texas Hotel, Fort Worth, Texas.

Apr. 22-23—Colorado School of Mines, annual engineer's day, Golden, Colorado.

Apr. 27-28-29—API, Eastern District meeting, William Penn Hotel, Pittsburgh, Pa.

May 2-4—ASME, spring meeting, New London, Connecticut.

May 2-4—Independent Petroleum Assn of America, mid-year directors' meeting, New Orleans, Louisiana.

May 8-10—American Institute of Chemical Engineers, Tulsa, Oklahoma.

May 9-10—American Gas Association, spring meeting, French Lick Springs Hotel, French Lick, Indiana.

May 11—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.

May 12-13—API, Pacific Coast District meeting, Biltmore Hotel, Los Angeles, Calif.

May 12-13—Instrument Society of America, spring meeting, Royal York Hotel, Toronto, Canada.

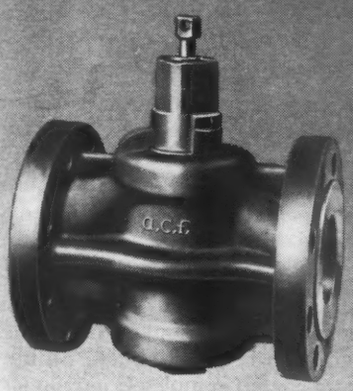
May 26-27—API, Rocky Mountain District meeting, Gladstone Hotel, Casper, Wyo.

May 26-27—The Natural Gas and Petroleum Assn of Canada, annual meeting, Hotel London, London, Ontario.

June 6-9—API, midyear meeting, Baker Hotel, Dallas, Texas.

June 6-11—SAE, summer meeting, French Lick Springs Hotel, French Lick, Indiana.

Cylindrical Plug design does not wedge



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PETROLIC PERSONALITIES

DICK SNEDDON

When a man bites a dog, that's news; but when the icy cold of California drives a Californian to Alaska, that my friends, is a phenomenon or something equally drastic. Bart Gillespie returned just recently to his cosy work at Barrow, finding it almost impossible to negotiate the snow choked avenues and boulevards of Los Angeles, without a dog team. (Incidentally, there are a couple of dogs in the city we would have recommended to him, but we always try to keep this column free from personal spleen). Anyway, just to give you an idea how terrible the Angelenic winter really was, Bart, who hadn't even brought his coat down with him, was fighting his way along Figueroa one night, bending far forward into the blizzard, and yelling, "Mush, there! Mush, you malamutes!" when out from the Jonathan Club came a waiter with a bowl of mush.

That's how good the service is there since they put Jerry Engstrand on the board of directors. Bart went inside, lighted his blubber torch (that's an Eskimo flashlight), peered around, and strike him pink if there wasn't Fred Ripley, Lee Laird, Tom Martin, Cal Calhoun, Earl Boggess, Mitch Mitchell, and a whole raft of Nomads thawing out their frozen tonsils with drafts of usquebaugh (Eskimo for "antifreeze"). It turned out to be a thoroughly enjoyable evening only slightly marred by the unpleasant realization that after it was over they would all have to tumble out into the rigorous California winter again.

While we are on the subject of Alaska, it is reported on good authority that J. Ralph Coleman has resigned his post up yonder, as chief petroleum engineer for Arctic Contractors, on Naval Petroleum Reserve No. 4, and now has his own reserve in Levelland, Texas. According to our operative, he is organizing a well servicing company in the Permian Basin. Ralph, a Lufkin lad, Lufkin, Texas, that is, graduated from University of Texas, and then developed a nasty case of wanderlust from trying to find a place to park. So up he goes to Alaska, where the nights are six months long, hoping at least he would get some chance to catch up on his sleep.

Well, after foraging around the frozen—some of the time—tundra for about four years, he made a stupendous discovery: He discovered that the chief nurse at the Barrow hospital for Eskimos was a fellow Texan who had all the attributes of an agreeable life companion, and Ralph, being nothing if he is not a man of decision, ups and marries her. Which merely shows that while the basic function of a nurse is to keep the patient's temperature down, sometimes her ministrations have just the reverse effect.

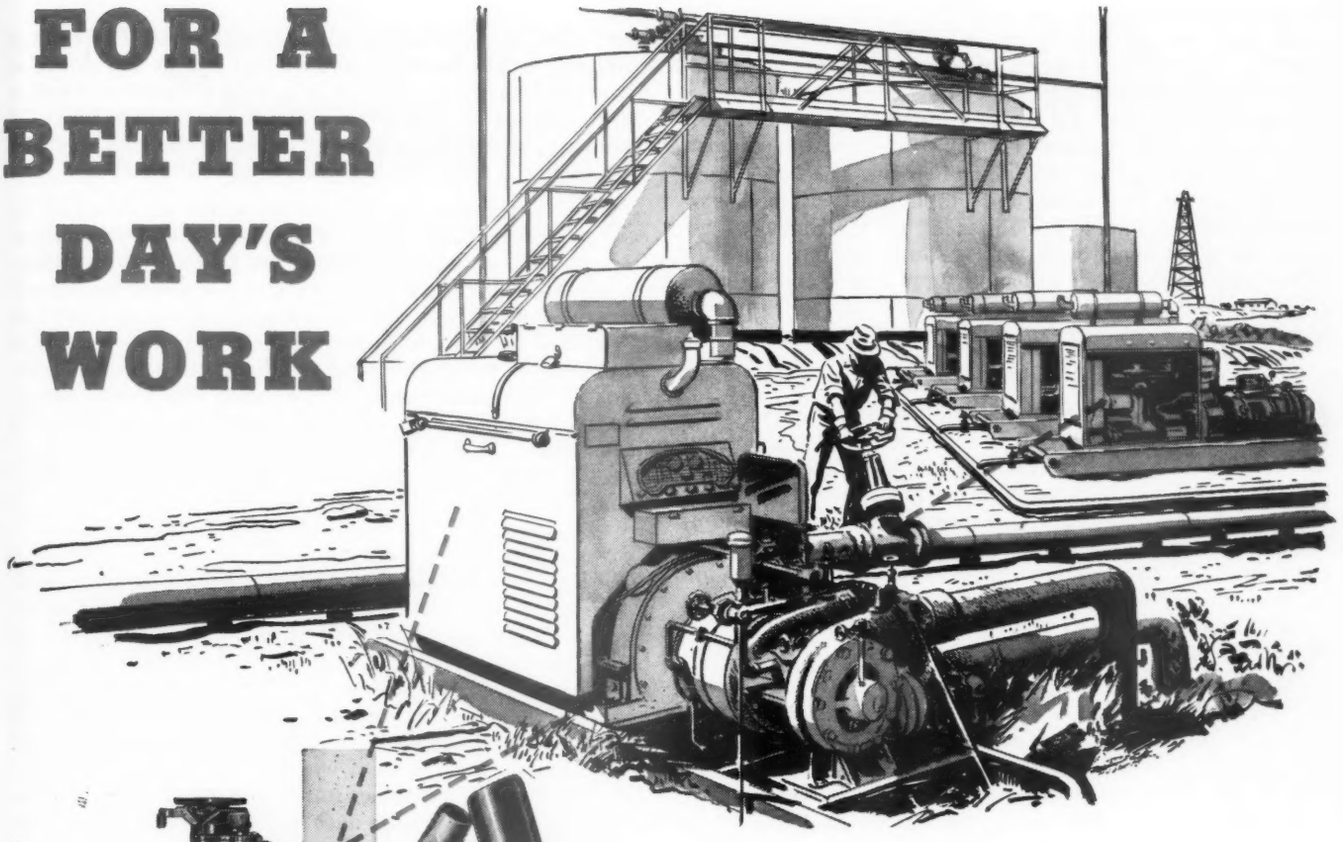
Ladies' day at the Petroleum Engineers Club at Dallas opened disconcertingly when one of the waitresses dropped her tray and ran screaming, to the exit. The chairman rapped his gavel for order, and demanded peremptorily what it was all about, whereupon the distressed maiden, pointing to Warren Jackson, declared, "That one pinched me." As can be well imagined, such an accusation, made in a really high class jernt, and with mixed company present, caused plenty of excitement. The assembled members and their ladies called loudly for some explanation of the unseemly act, and after many charges, denials, and counter charges, in which the Club's past prexy, Dewey Jordan, was excessively active, all discussion had to be abandoned. A suggestion by Dewey that a fine be levied on the philanderer, merely brought the retort that anyone who is so careless as to lose an eraser in his own ear, certainly is poorly qualified to sit in judgment on others. Dewey, Atlantic Refining Company's production chief at Dallas, had an accident a short time ago that transferred an eraser from his lead pencil to his aural appendage, and it took an M. D. to get it back. We have also heard tell that he boarded the API special in November a champion gin rummy player, and came back from the Convention with a chastened mien, and a firm resolve not to participate in any more gin rummy conferences. We might mention in concluding this highly educational paragraph that in the case of Warren Jackson vs. the outraged serving gal, the whole sordid affair was finally proved to have been prearranged, and he now stands a free man with an unblemished reputation, unless he has been guilty of other misdemeanors of which we have not yet been informed.

Frank Champion, the Paul Bunyan of the petroleum industry, about whom has circulated so much of lore and legend that some budding Bullfinch might easily and profitably compile a Champion mythology, is by no means to be the end of the Champion saga. Word comes out of the inner sanctum at Dallas that a scion of this noted house, to wit, Johnny Champion, although a smaller edition of his illustrious pop, has all the parental traits only more so. Johnny has been standing the SMU football fans on their ears back there every time he goes into a game, and has endeared himself no end to his teammates because of his morale building propensities. He is a Lamar High School graduate, still just 18 years old, only 5 feet 6 inches high, but with more drive in his 165 lbs than there is in a pack of bulldozers.

What, no doubt, makes Champion Senior prouder than the proverbial peacock is that the kid completely lacks what the English call "side." He seems to be a born mixer, with a quick wit, and he makes friends easier than Dale Carnegie. You football patrons, keep your eyes on this lad—you're gonna be hearing more about him.

On the evening of the Wildcats' famous High Jinks in the Los Angeles Biltmore Bowl, we popped into Pittsburg Steel Company's office up in the Richfield Building at Flower, and quickly found ourself completely surrounded by conchologists. Shell people, that is. There was "Pen" Penfield, erstwhile rope choker, and much traveled drilling chief; Jack Gignoux, who scarcely wilted when we bombarded him with a ceaseless fire of our high school French—the brave fellow; Jim Gregory, Sierra Madre whatnot designer, and distinctly promising young engineer; Sam Bowlby, personable, friendly, and capable executive; and other interesting Shellites whose names escape an old mind rusty and dull from desuetude. From "ither airts," to wax Scottish for a minute, came genial Buck Weaver, Union Oil's contribution to the dignity of the purchasing profession. Then they began streaming in too fast for us to count, so saying our goodbyes to genial hosts, Wallace Rowe, to saying our goodbyes to golfing whiz, Wallace Rowe, Pacific Coast manager of Pittsburg Steel, and Earl Cater, sage of the San Joaquin Valley and what the trade calls "a

FOR A BETTER DAY'S WORK



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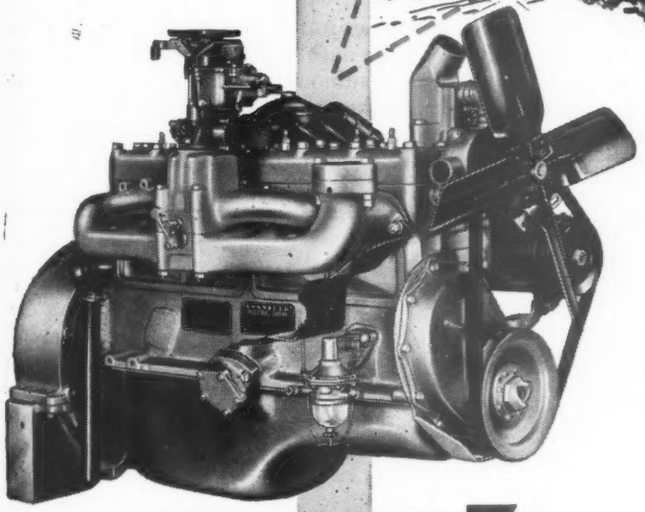

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swell Joe," we ambled on for a brief sojourn with Dave Conklin, the duPont biggie, and George Tyler, his right-hand man. Thence to the Guiberson hideout and traded a wisecrack or two with Ed Embury, another young engineer who is well up the success ladder; Nat Haseltine, pianist, composer, and nephew of Dick Guiberson. The latter, incidentally, was having an uncomfortable joust with a case of bursitis and was unable to be present. but Ed Embury scattered the good cheer with typical Guibersonian abandon. Wherewith we thank all and sundry for a good time, and to Dick our sincere hope that the current year will see him back to his customary good health and spirits.

Our Texas operative reports lamping many vipps (very importink petrolic pipple) in his journeying about the continent. Won't have room to tell about them all here, but one was Gene McElvaney, vice president of the First National Bank of Dallas, who dishes out loans of astronomical proportions to oil men who can prove that they don't need them. When not listening to the urgent plea of some lad with an expansion complex, the estimable banker likes nothing better than to sit at the console of an electric organ, flitting from Bach to Beethoven. and then from Beethoven bach to Bach, if you know what we mean. It's all very confusing.

Also worthy of mention is Bob Chan, executive vice president of Magnolia Petroleum Company, whose travels in behalf of his company make Marco Polo look like a sissy.

He has been to nearly every foreign producing field in the world, which makes us jealous no end. Personally we are an old stay at home—but our mind travels quite a bit. Also, our Uncle Angus was quite a chap to get around. He started off from Scotland on a trip around the world on the installment plan, and we have never seen him since. The railway company, wrote, however, and told us that he fell down on his second payment when he was in Afghanistan. Further on the subject of travel, Glenn Bush, the popular Ohio Oil Company exec at Tulsa, tells of a driller who took his wife with him on a train trip into a nameless oil area.

When he returned he sent a letter to the president of the railway, telling him in no uncertain terms what he thought of a transportation company that had such lou—poor facilities. He explained that he had managed to get a seat for himself all right, but his poor wife, who wasn't a bit strong, had had to stand all the way. And apropos the rivalry between Dallas and Houston, we always got a real bang out of C. K. "Rope Choker" Stillwagon's story of the rousty who was in church one Sunday morning, when the minister concluded his praver with, "God bless the pure and the humble." "Amen." said the rousty, "But don't forget about Phillips and Magnolia."

We have just learned that Al Rhea, chief petroleum engineer for the Sun Oil Company at Dallas, is one of the industry's most proficient gin rummy players. At least he has very casually nicked for small change several people who profess to be proficient at this fascinating pursuit. It has nothing to do with Al, of course, but it has been our observation that petroleum engineers are usually very good on the draw—regardless of whether it is a cork or a card they are after. On the other hand, they don't seem to be so good at crap shooting. We once knew a young engineer who took to the galloping dominoes and the poor fellow was faded before he reached the age of 25. And Art Heiser, Ned Brown's right hand man, says the best hand he ever held belonged to a blonde waitress in Midland, Texas.

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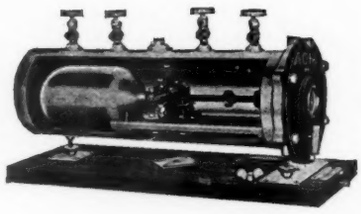

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THE Petroleum Engineer

FEBRUARY
1949

Oil in the Land of the Rising Sun

By CAMPBELL OSBORN*

THIS story is an effort to give American oil men a birdseye picture of the Japanese petroleum position during the past 20 years. It is complicated and scrambled, and obviously all that can be done in a short summary is to hit some of the high spots.

Japan is not, and has not been, and probably can not be a nation of motor vehicles like the United States. The standard of living is too low and the economy can not stand the expense. It is questionable whether the Japanese ever had more than 15,000 motor vehicles, busses, trucks, baby cars, and scooters. They had 10,000,000 bicycles. It is a nation of railroads and electricity (one of the most highly electrified nations in the world), and of innumerable push carts. But it was, and probably will be again, a great industrial nation judged by Oriental standards.

The quality of its products was low and would not meet the requirements of the western market and they were largely imitations of ours and of the British and the Germans. The Japanese turned out a stupendous volume of them and they satisfied the Oriental market. They were ahead of the Russians, and were far and away ahead of any other nation between the Pacific and the Black Sea. They were a great marine nation and the greatest fishing people on the face of the earth. Consequently they used large quantities of diesel and lubricating oils, and some fuel oil.

To understand their oil picture you must forget all about American standards of consumption and of living, most of what you know about reserves and modern production technique and refining methods, and practically all your knowledge of transportation. Forget also about the western way of life. Remember only these things. There are more than half as many people on their islands, not so big as California, as we have in America. We produce in one day much more oil than they do in a year. They are industrious and ambitious, and more than any other nation, they admire the American people. They were completely monopolized by the "Ziabatsu" families. In Japanese "Ziabatsu" means trust. There was just a handful of them. The Germans cultivated them. Their Government was modeled after that of the Teutons. It was a compromise. It fitted their emergence from feudalism and complete isolation about a century and a half ago. The supreme power was in the Emperor, not the legislative branch as in our country, except during the New Deal. He was dominated by the Army, and the Army was over-ambitious. The Japanese people were like a flock of sheep. This background is given only because it is necessary to understand what the Japanese oil position was before the war, and during the war, and what it may be in the future.

Twenty years ago Japan produced and imported about 5,000,000 bbl of crude oil a year. They produced less than 3,000,000 bbl. In fact, they at no time have produced on their own islands more than 3,000,000 bbl a year. The resources are not there. From us they imported the bulk of the deficiency and from the East Indies the remainder. In addition, they imported about 10,000,000 bbl of refined products annually.

At that time the petroleum industry of Japan was in the hands of private interests. The supply of oil was adequate. The country was prosperous, judged by Japanese standards of prosperity. Life was easy in Japan in those

*In charge during 1946 and 1947 of the Japanese manufacturing industries in the army of occupation.

EXCLUSIVE

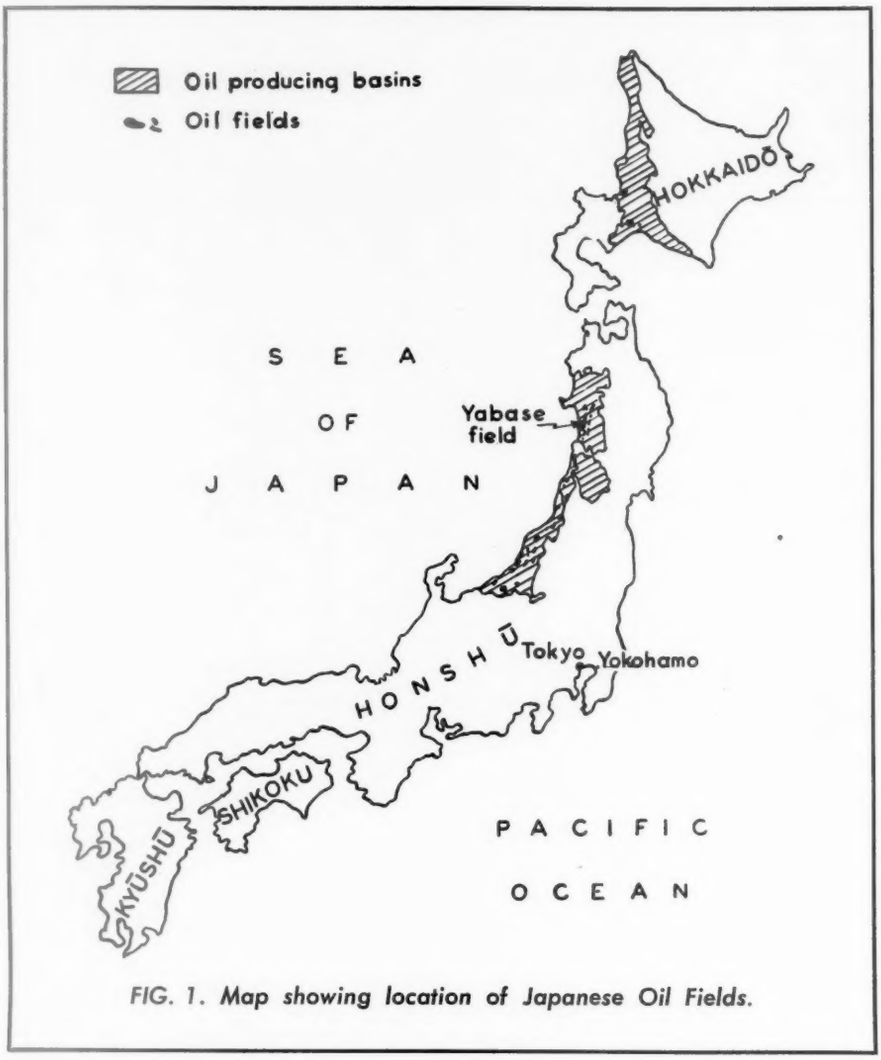


FIG. 1. Map showing location of Japanese Oil Fields.

years for anyone who had any money at all. This prosperity continued during the time that we suffered our great depression. In those days the yen was worth 25 cents. Now it is worth ¼ of 1 cent and rapidly declining.

About 1934 something happened in Japan. Somebody got some ideas. It was thought to be Tojo and his crowd. At any rate there was a drastic change in the petroleum picture.

No nation can become belligerent without a lot of oil and Japan did not have it. Crude production rose a little, but not more than 3,000,000 bbl a year. Consumption increased slightly with national prosperity. Imports rose sharply, and the pattern of the imports was radically changed. It must have been about this time that the war lords of Japan decided to conquer the Orient. They had the Emperor under control (would doubtless have assasinated him if he had not gone along) and the Japanese people had been taught to worship their Emperor. The decision was that Japan would import more crude oil, build refineries and process it herself, and stock crude oil, and if the need arose, seize the countries that were near at hand that produced crude oil.

Accordingly, the Petroleum Law was promulgated and the government undertook to supervise the industry. Permits were required for importation and for refining, market quotas were fixed for each company, and importing firms were required to stock a six months supply, whether they needed it or not. Then came the Synthetic Oil Law, the Law for Exploitation of Oil Resources, and finally in 1941 the Imperial Oil Company Law. The industry had become a public utility. In other words, the Japanese Government, dominated by the military, mindful of what was coming, or what they were going to bring about, did the following things. A Government official became a large stockholder of the Imperial Oil Company. The company was permitted to squeeze out all but 5 per cent of the independent producers of crude oil. A subsidy was granted to the Imperial for drilling costs. Storage tanks were built far beyond Japan's peacetime needs for oil and filled as rapidly as possible with California, Texas, and East Indian crudes. Numerous small plants, well dispersed on their Pacific Coast and remote from their fields, were built with government aid and sympathy to refine this crude, and synthetic oil plants were constructed to process coal for the recovery of liquid fuel.

By 1937, at the time China was attacked, the supply of crude had risen about 100 per cent above what it was three years before, mainly imported crude, far beyond the normal requirements of a peaceful Japan. It reached a peak of about 22,000,000 bbl just before Pearl Harbor. At the same time stocks of refined products had been upped to about 38,000,000 bbl. Japan's oil war chest was thus about 60,000,000 bbl.

Not long before Pearl Harbor imports of crude began to drop abruptly because we cut off our exports from California and Texas and the Japanese were unable to get the crude they wanted from the Dutch East Indies. Imports of refined products from us also vanished. Their oil war chest was insufficient, and by 1943, despite their utmost efforts their crude imports were again at the normal peacetime level, refined products had been largely used up, their taxicabs and cars were burning wood and charcoal, their Navy was operating on fish, soybean, and corrosive pine root oil, and their planes with 90 octane gasoline. They were finished and done for. The outcome was to be expected. So much for the historic period up to the surrender.

Americans look largely to the future. What oil men are interested in is what the condition has been since the war ended in September, 1945, and what it is going to be from now on.

When MacArthur moved in, the petroleum picture was about as follows: The Japanese islands were about out of oil except for the 5000 to 6000 bbl a day they were taking from their own fields. Crude stocks had dropped from 22,000,000 bbl to less than 500,000 bbl. Imports had vanished. Refinery consumption of crude was roughly equal to the domestic production. Production and stocks of finished products were off correspondingly. If we assume that 1934, just before they began to get ideas of conquest, was a normal peacetime year for Japan, in which they imported about 28,000,000 bbl of crude and products and produced about 2,000,000 bbl, we must arive at the conclusion that they were down to about 5 per cent of their actual needs for ordinary civil life.

Something had to be done about it to prevent disease and unrest and to

bolster the economy so that it would not break down completely. Accordingly a committee of men in the Army who had had experience with the American oil companies was appointed to advise General Headquarters and to take charge of imports and in general to supervise all petroleum matters in Japan. Of course, long before these petroleum products had been rationed by the Japanese Government, and this was continued. Shortly after the occupation began the Pauley Commission was sent to Japan to study the oil position there and to make recommendations on the disposal of the excess refinery and storage capacity that had been built by the war machine.

There has been little change in the crude producing picture since the occupation began. It seems unlikely that there will be any improvement in the years to come. With uneconomic drilling and Government subsidies the highest figure they were able to reach was in 1937. It amounted to 2,473,000 bbl for the whole year. It has slumped since then and is now probably in the neighborhood of 1,300,000 bbl per year.

What is left of the Japanese Empire consists of four islands, Hokkaido on the north, Honshu in the middle, Kyushu on the south, and Shikoku on the inland sea adjoining Honshu. The fields in northwestern Honshu adjoining the Japan Sea, known as Akita and Niigata, produce about two thirds of the total. The remainder is produced by some small fields in central Hokkaido. Although there are about 50 fields and 5000 wells, the proved and developed acreage is only 11,450, and the average daily production per well is less than 1 bbl. The best fields in Honshu have yielded 35,000 bbl per acre, the average 10,000 bbl. Hokkaido recoveries have been 875 bbl per acre. According to the geologists in the Natural Resources Division of General MacArthur's Army, proved oil reserves, as estimated by production decline curves, can be recovered only at an average cost above world levels ,and the proved undrilled reserves are trivial.

The following summary, prepared by the geologists referred to, is probably as good a review of the petroleum prospects of Japan as can be found:

"Estimates of the possible but unknown reserves of the producing districts of northwestern Honshu are 14,000,000 kiloliters (one kiloliter equals 6.29 bbl, plus a speculative, but possibly large amount, that may be derived from basal Miocene horizons below the present producing zones. Although the yield from Neocene horizons in central Hokkaido is virtually uneconomic, no tests have been made of Paleocene and Cretaceous horizons which are oil-bearing in outcrop. Should these older horizons prove productive, larger fields than those yet found in Japan could result because of the more favorable structural conditions which appear to exist in north-central Hokkaido.

"Very little attention has been given to prospects in other sedimentary basins. Oil seepages are known in eastern Hokkaido where a large poorly mapped Tertiary basin exists. There are also Tertiary embayments on the Pacific Coast of Honshu which warrant further investigation; one such basin in Shizuoka Prefecture has produced a small quantity of oil and oil indications are known in others.

"The industry is operating with the aid of Government support and its future is dependent on locating new oil resources, the existence of which remains to be proved by further exploration. The industry has adequate resources in equipment and trained personnel for a substantial drilling program, but the intensive drilling campaign and the virtual cessation of exploration during World War II left few prospects suitable for drilling.

"The application of geological science to oil exploration in Japan is more backward technologically than was expected. Areal geological mapping in the producing basins is incomplete and unreliable. Geophysical methods have only been applied on a small scale during the last three years to extensive and significant alluvial areas. Regional subsurface studies have not been attempted and the application of micropaleontology to regional correlation has not passed the basic research stage.

"While the geologic picture and past records of the producing districts do not encourage the expectation of major discoveries, important territories undoubtedly remain, both within and outside the present producing districts, which are either imperfectly known or to which modern techniques of exploration have not yet been applied."

The Japanese are not unacquainted with modern drilling and producing technique. They have made extensive studies of American equipment and practice, and have imitated them with a considerable degree of success. Wells to a depth of more than 11,000 ft have been drilled by them in Formosa. Because of the unavailability of hard steel their drilling time is longer than ours and replacements are more frequently required. The Imperial Oil Company has over 50 strings of tools. They are also acquainted with modern completion methods, but they have yet much to learn concerning up-to-date lifting practice. Less than one per cent of the wells flow. The gas lift is not used. Nearly all wells are pumped with central power. Electric power is used for most of the drilling and all the pumping.

From a tourist's standpoint the most interesting feature of the Japanese oil industry would be the Kazusa drilling system for shallow holes. It is

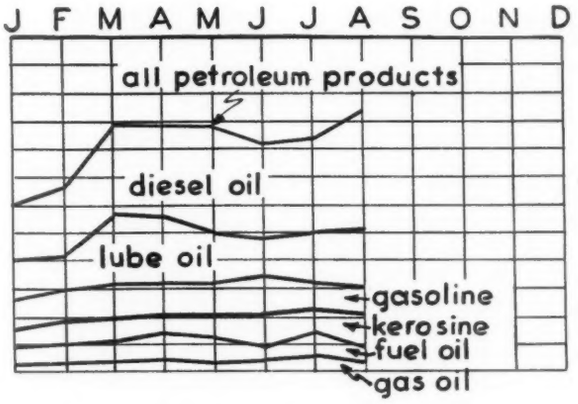


FIG. 2. Normal peacetime market for petroleum products in Japan. Relative volumes only. "All Petroleum Products" equals 100 per cent or about 30,000,000 bbl. Based on Japanese refining practice.

OIL COMPANY FORMED TO EXPLORE ABROAD

Continental Oil Company, Ohio Oil Company, and Amerada Petroleum Corporation have organized Conorada Petroleum Corporation, in which each has a one-third interest, to join efforts to investigate prospects for developing properties abroad. Conorada will have headquarters in New York City. Purpose of the company is to conduct comprehensive investigations, including foreign geological exploration, and conduct negotiations for acquisition of prospects considered favorable for production of oil.

Directors of Conorada include L. F. McCollum and James J. Cosgrove, Continental; J. C. Donnell, II, and W. B. Emery, Ohio; and A. Jacobsen and E. H. McCollough of Amerada. Arthur A. Curtice is the seventh director and corporation president and will be in direct charge of operations.

Curtice is a well-known consultant in geology and petroleum engineering and has been associated with Hoover, Curtice and Ruby, Inc., and its affiliates.

The name of Hoover, Curtice & Ruby, Inc., which continues in business, has been changed to Exploration Contractors, Inc.

still used in some isolated marsh gas districts. It is primitive; like the fragile antique homes of the Japanese in the shadow of Tokyo's modern office buildings. It is a type of percussion drilling depending upon manual labor for power. A chisel-like cutting tool is attached to bamboo joints to make a drilling line. When the drilling line is removed from the well it is wound around a large spool. Men and women step on the beam in unison and in some rigs platforms are built one above the other to accommodate this human power.

American refiners who believe that an assured source of crude is the first essential for successful operation will be shocked when they compare the production figures just cited with the refinery picture in Japan. There are several refining districts—those near the oil fields in western and northern Japan, one in the Tokyo-Yokahoma area, and other districts on the Pacific Coast. In all there are about 25 plants. The rated capacity of the plants near the oil fields is about 20,000 bbl per day. They are old. The Pacific Coast plants were designed to refine imported crudes of the Kettleman Hills and Rodessa types. The Tokyo-Yokahoma plants processed crudes imported from the Dutch East Indies primarily for lubricating oils. The basic capacity of all the Pacific Coast plants was about 90,000 bbl per day. They could crack 40,000 bbl daily and their vacuum capacity was about 23,000 bbl daily. It is estimated that the over-all capacity of the Japanese refining industry in 1943, before bombing, was about 110,000 bbl per day. Bombing cut this down roughly one-half, but repairs are not difficult. Catalytic cracking was practically unknown, and the Japanese depended upon additives to up-rate the quality of their aviation gasolines.

As the situation now stands, the Japanese have refining capacity nearly twenty times their production of crude oil. Judged by our standards, these plants are in a deplorable condition. Bombing and fire damaged them greatly. Some that were started during the war were not completed. Others after completion were not operated because of the lack of crude or defects in design. The Japanese attempted to borrow our designs, but in many cases laboratory research proved to be more theoretical than practical, and the explosions and fires that followed gave them many headaches.

Before and during the war the Japanese embarked upon a large tank building program. Most of it was obviously for war purposes and had no relation to normal refining and distributing operations. The total capacity at the end of the war was about 40,000,000, exclusive of small bulk distributing stations; 15,000,000 bbl, or enough for 90 to 120 days at the rate of use in 1934, would have been sufficient.

There is no better way to control a country's war-making capacity than by limiting its petroleum refining and storing facilities. In the Pauley reparations report it was recommended that all refinery capacity in excess of 40,000 bbl per day, and storage facilities in excess of 10,000,000 bbl be removed. He was probably high on the refining capacity and low on the storage facilities he would leave in Japan. Three years have passed since the armistice was signed and little has been done to carry out his recommendations. Some of the plants have been permitted to convert to the production of ammonium sulphate for fertilizer, and China has been given a 15,000 bbl plant at Taiwan, built there by the Japanese. In the writers judgment the Pauley report should be acted upon promptly, the refinery capacity cut down to meet Japan's own crude production, and the storage facilities reduced to 15,000,000 bbl. The sooner this is done the sooner will be restored the normal pattern of imports of refined products that existed when Japan was a peaceful nation.

It is presumed that, in the course of time (when the Russians get ready for it) there will be a peace treaty. If the Japanese are given a chance the writer believes they will restore their normal economy. In 1931 they imported about 10,000,000 bbl of light refined products and the same volume of crude and heavy oils, a total of 20,000,000 bbl. In 1934 this was increased to 18,000,000 bbl of crude and heavy oils, while light oil imports remained the same, a total of 28,000,000 bbl of all oils. Add domestic production to this and you have 30,000,000 bbl a year. This, in the writer's judgment, is a good yardstick of Japan's normal oil needs. Leave them enough refining capacity to take care of their domestic production, and enough storage to enable them to handle a six month's supply of oil at the rate of 30,000,000 bbl a year. Their refineries would be of no use to us and their storage tanks can not be moved to the United States and re-erected at economic costs. What remains should be scrapped. It is seriously questioned whether the refineries in excess of Japan's needs to process her own crude could be moved and put into operation on a competitively efficient basis in Australia or China or the Philippines, or in any of the other nations that were at war with Japan.

The normal peacetime market in Japan for petroleum products is illustrated by the accompanying chart. The largest market would be for diesel and industrial lubricating oils. There would be lesser markets for gasoline, kerosine, gas oil, and fuel.

At the present time the imports that are permitted are handled by the Army and Navy and paid for with our funds or with the meager income from Japanese exports.* The oils are handed over to the Japanese Government or its satellites and distributed in accordance with plans that are approved by General MacArthur's organization. The price is high and there is a woeful shortage of all kinds of oils in Japan for essential purposes. If and when the time comes that American exporters of petroleum products can do business with Japanese importers directly, or with American or British-Dutch distributors in Japan, on the basis of international competitive prices, with due allowance for tanker rates and taxes, the writer suspects that this country again can and will supply Japan with the normal peacetime share of her needs for refined products that we furnished before Tojo and his crowd began to get big ideas. * * *

*Since this story was written a press dispatch from Japan states that General MacArthur has turned the petroleum industry back to private enterprise. Presumably this means that Japanese importers will handle oil imports in the future rather than the Navy with SCAP supervision.

EXCLUSIVE

History and Analysis of Bureau of Mines' PETROLEUM AND NATURAL GAS DIVISION

ERNESTINE ADAMS*

PART 3. History 1930-1948—Amid depression waste, conservation agency got inadequate funds but managed to come to government's rescue with important data for war.

▸ **Depression Hits Division.** The lavishness of the 20's disappeared into the truculent 30's and leaf-raking projects of the government cut into research projects of the Petroleum and Natural Gas Division. By 1934 appropriations, which had doubled in the 20's, were back down to $111,000 for the year. It was not until the latter part of the decade brought the threat of war that the sag was taken up.

At the beginning of the economic depression the total investment of the oil industry was estimated at 12 billion dollars, a far figure from the half billion estimate set on it at the time the Division was established in 1914. The money value of the industry investment diminished in the 30's, then bounced back during the war and pushed on to some 20 billion dollars in 1947 with good profits to speed its growth in the future.

The kindest way to describe the middle 30's is to call it a fallow period. There was no incentive to harvest new methods of efficiency when there was too much of everything with the old methods. In the oil industry federal and local governments squared off and fought over which should control conservation of oil and gas. The industry was awash with oil that flowed from the big discoveries in the Mid-Continent area topped by the East Texas discovery in 1930. The federal government wanted to add oil to its handling of other surpluses. (This was the era of plowing under every third row of some crops and killing off some of the prolific crop of pigs) and the states were determined to regulate production.

Local authorities finally won out and the result was the Interstate Oil Compact, a remarkable testimony to the practical relationship of democratic government and free enterprise.

The Petroleum and Natural Gas Division of the Bureau of Mines was not the means by which the federal government expected to control the industry. The Federal Power Commission might have been the agent or a special administration could have been appointed. The Division retained its complexion of a research body and not a regulatory body. When the Interstate Oil Compact Commission began to be concerned with conservation regulations, the Division continued its study and information distribution on economic practices. Some of the most important researches in its history came from the Division in the enervating depression period.

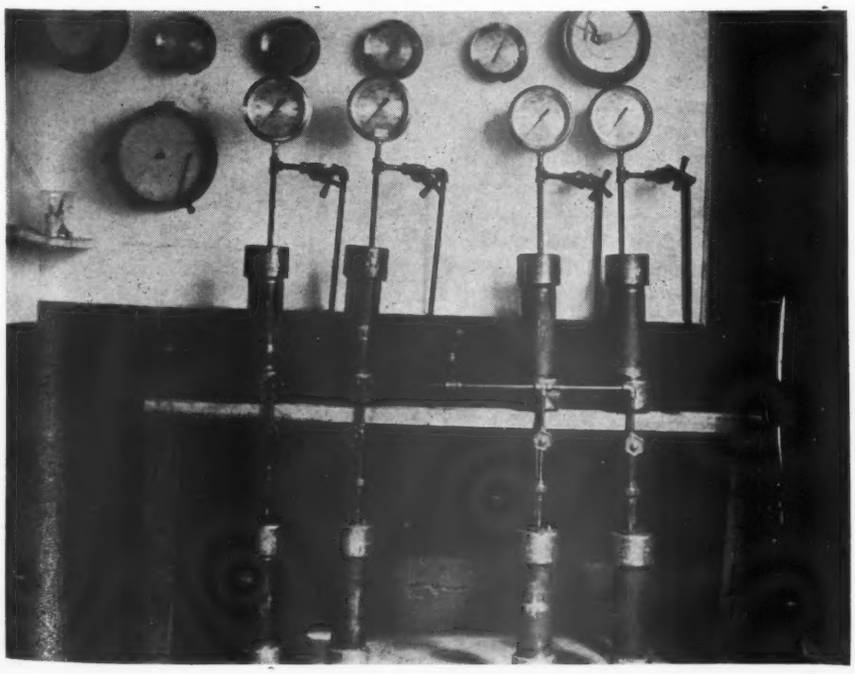
▸ **Milestones in Operations.** Hill's paper on the Williams pool in Texas (1930) showed the results of air repressuring on leases operated as a unit for increasing recovery by secondary methods. In later years the study provided valuable aid in developing the pool by water flooding. An investigation by Chalmers, Nelson, and Taliaferro in the same year added to the information on oil recovery by gas drive.

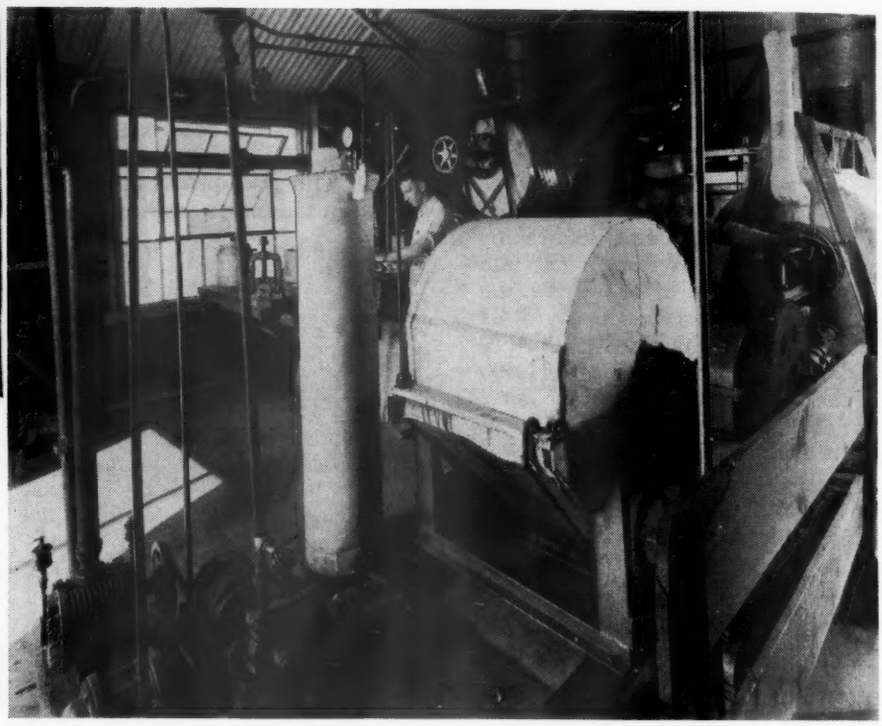
In his history of the Salt Flat and other fault fields in 1931 Hill called attention to production characteristics in limestone and sandstone reservoirs. He followed this with a paper on crater wells the following year that pointed out the tricky nature of migration of gas from lower to upper formations and described the untold damage resulting from a few wild wells.

Lindsly contributed a paper on solubility and liberation of gas from natural oil-gas solutions and an investigation report on bottomhole samples of East Texas crude oil in 1933. The latter is considered the first compre-

*Managing Editor, *The Petroleum Engineer.*

Early set-up for accelerated hydrogen sulphide corrosion tests by Bureau. This was taken about 1929 but the first report was released in 1932.





Study of oil wastes began in early Bureau of Mines history. Bartlesville station put in an experimental plant near El Dorado, Kansas, to study recovery of wax from emulsions. Below is inside view showing details of vacuum filter system.

hensive report made on solubility and shrinkage characteristics of reservoir oil taken from bottom with a specially devised sampler.

A study of subsurface pressures and temperatures in flowing wells in East Texas (1933) by Reistle and Hayes enlarged the literature on reservoir conditions.

In 1936 Carpenter and Hill made the first formal engineering report published on limestone reservoirs in West Texas oil fields. It serves as a reference on engineering information concerning a variety of West Texas fields from Westbrook, the least productive, to Yates, the most productive. Appropriations were so low that the Midland, Texas, Chamber of Commerce financed the printing, selling enough copies to pay for the investment.

An outstanding contribution to the study of condensate production and phase behavior was made by Eilerts and associates. In 1938 Eilerts and Schellhardt reported on the investigation of what they called a "combination" well, because it produced distillate. The study concerned a well drilled to the Trinity formation in East Texas.

A still more valuable work was the investigation of reservoir liquid and properties, and their effect on production made by Eilerts, Smith, and Cook in 1939.

Miller and Higgins brought Cutler's (1924) rules of well spacing up to date to put them in line with advances in production methods.

Engineering studies continued and improved in the light of new information. The report on the Oklahoma City field (1937) in particular has been used as a model for young engineers in private industry.

On the refining side the black oils of the Rocky Mountains were the subject of a project to evaluate their refining values and their future economic importance. It was begun largely for the purpose of supplying the Rocky Mountain area with more petroleum products from its own fields and plants. The value of the work rose quickly with the advance of war.

Espach and Rue reported (1931) that gasoline could be produced from sulphur-bearing oil by certain methods without as much chemical treatment as had been used, thus having smaller losses. A survey of the high-sulphur crude oils in Wyoming was made by Thorne and Murphy in 1932.

Asphalts—as products of black oil—were the subject of special research at the Laramie station, which in 1935 was reestablished on the grounds of the University of Wyoming. An analytical method was developed for asphalts, and crude oils that produced asphalts were taken from areas from Canada to Mexico for examination. Tests proved the relative values of the various asphalts and refuted the common belief that Wyoming asphalt was inferior.

A barrier to the better use of high sulphur crude oils is imperfect knowledge of the sulphur compounds that these oils contain, and the Laramie Station is still working on chemical problems connected with Rocky Mountain black oils.

The long history of the Division's research on oil emulsions, the oil waste from wells that was often burned in the sludge pits, and some methods of conservation were covered by Shea in a bulletin in 1939. His opinion was that the trend was toward prevention of waste rather than development of treatment. It was emulsions, however, that were studied by Division engineers to develop a process for recovery when the product was scarce during the war. This project was based on the 1938 technical paper of Horne and Holliman describing solvent analytical separation of waxes from petroleum.

Monographs 6 and 7, the twin aids of the gas industry, were both released in the 1930's. The Division co-

operated with the State of Oklahoma and the Natural Gas Department of the American Gas Association on this fundamental research. Monograph 6 is on the flow of natural gas through high pressure lines by Johnson and Berwald. Monograph 7, by Rawlins and Schellhardt, discusses back pressure data on gas wells.* Said one company executive of Monograph 7: "Although developed years ago the natural gas industry still relies upon the basic concepts developed in this study."

Conclusions of research by the Division on corrosion of steel were first published in 1933 (Wilhelm and Schmidt). The subject has received minor attention since and one pipe line company president states that he believes it definitely desirable that the Bureau continue to study corrosion of steel, a subject that requires a large amount of attention by industry.

The nice position of being needed came to the Division when its appropriation was at its lowest. In 1935 demand from automotive and petroleum industries renewed the gasoline surveys that had been instituted in 1919 to test motor gasoline quality and had been dropped in 1931 because of small appropriations.

Under the new setup the surveys were made in cooperation with Coordinating Research Council. The Division was supplied by individual oil companies with results of their private surveys on competitive gasolines. The Division tabulated these data and released the survey. This was the arrangement in effect until 1948. The motor gasoline surveys are now made in cooperation with the American Petroleum Institute.

Beginning in the early part of 1947, a new semi-annual survey entitled, "Survey of Commercial Aviation Gasoline Characteristics," was begun in cooperation with the Coordinating Research Council. The first survey was R I 4273, "Survey of Commercial Aviation Gasoline Characteristics, March 1947 Production," by Holliman, Baker, and Potts. The CRC contributes about $2500 annually to the work to help defray cost of laboratory work carried on at the Bartlesville station.

In its helium project the Division made strides in the quiet of the 30's. The staff devised a purification process for helium that had been used and recovered, thus conserving supply. Division men developed a new process for the extraction of helium from natural gas that pushed down the price from $32 per 1000 cu ft to approximately $15 per 1000 cu ft.

Amarillo is the headquarters for the helium work, but currently, the Amarillo plant proper is in standby status and all production of helium comes from the Exell plant. The Exell plant processes gas from the Panhandle region, which then goes into the Canadian River Gas Company's pipe line system. Any excess helium production at Exell is conserved by injection into the Cliffside field. The Cliffside field is owned by the government and gas production can be controlled so that it need not be used so long as other natural gas going into commercial pipe lines can be processed for helium. This system allows the utilization of helium that otherwise forever would be lost.

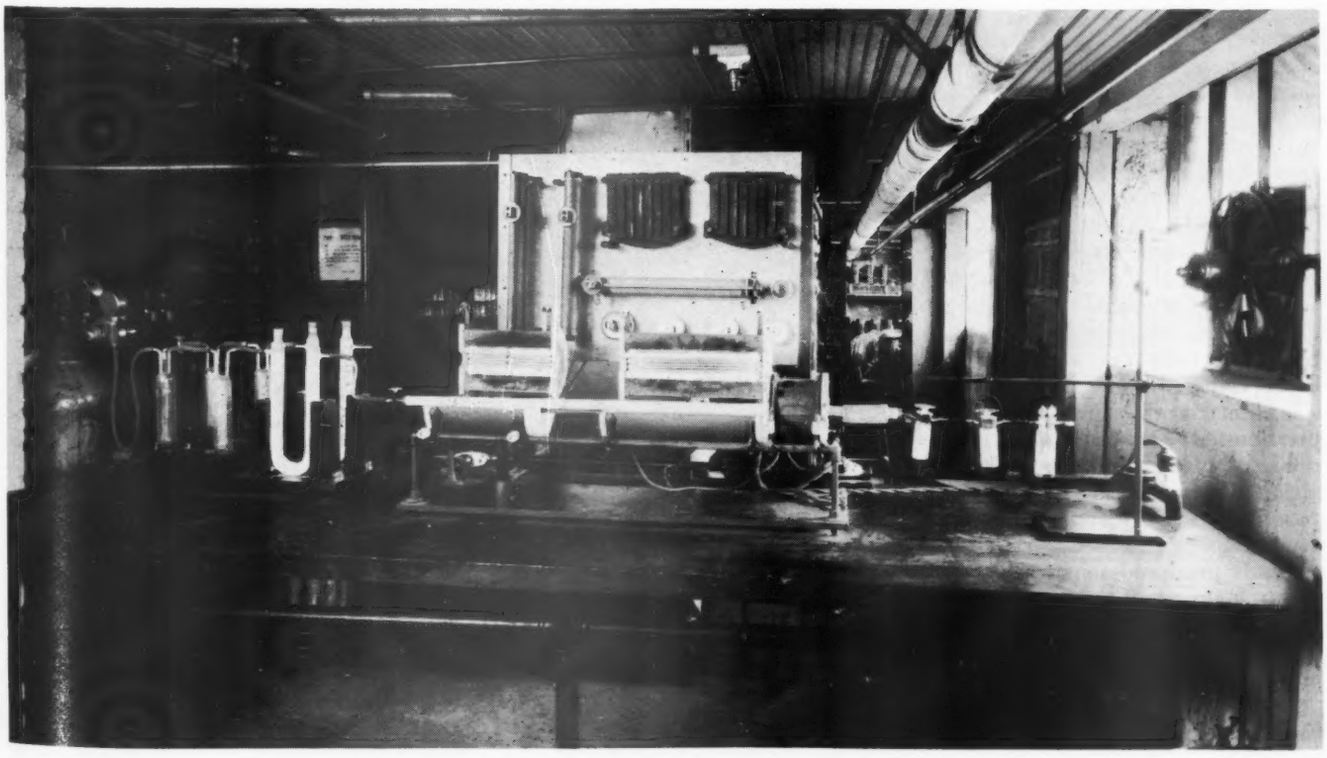
The 30's saw a large slump in the number of government publications on petroleum released by the Bureau. At the same time there was an increase in publication by periodicals of papers by Bureau men. This seems to have been a sound trend and it may be the best answer to increased dissemination of material gathered by the Division.

The dearth of funds induced the cooperation of the Division and other organizations to undertake specified projects. The Division has always worked closely with other components of the Bureau and with other departments of the government. There were early cooperative agreements with states and a natural growth of cooperative projects with associations in the industry.

This trend toward more research programs undertaken by the Division in combination with various organizations outside the government was a cheerful and inspired answer to crippling appropriations. The sizable

*See Page E-5, this issue.

Apparatus for carbon-hydrogen determinations of solvent extracted oils used in late 20's and early 30's.



C. W. Seibel

The success of the government helium plant is due in a large degree to C. W. Seibel, who joined the Bureau of Mines in 1917. Born in Kansas City, Missouri, he went to the University of Kansas for B.S. and M.S. degrees and later taught chemistry there.

After working at the old Fort Worth helium plant he was transferred to the cryogenic laboratory in Washington in 1922 and returned to the new Amarillo helium plant in 1930 as supervising engineer. Since that time he has remained in charge of all field activities of the Bureau relating to helium. During World War II he supervised the design, construction, and operation of four new helium plants.

number of the cooperative agreements (Appendix B*) in force today shows a continued healthy development in this direction. The plan helps to eliminate duplication of research work and lessens the time lapse between completion of a project and announcement of the results.

The effect of the depression upon the Division thus was not all bad but the purpose of the group was sadly restricted at a crucial time. Over-production and collapse of prices combined to create the worst enemy of conservation, whose oldest champion was pinned down by insufficient appropriations. When the industry most needed the encouragement of the Division toward sane and economic practices lack of funds forced the group to cut down its program drastically. It produced its own waste, in research closed off before results were obtained. At a time when deficit spending expanded to cover alphabet projects for the farm and the theater, for museums and miners, government petroleum research was squeezed to half its former financing.

▸ **Problems of Modern War.** When World War II loomed the Bureau men in the Petroleum and Natural Gas Division must have thought "This is where we came in." The requests for information read much as they did when the new-founded Division provided answers to problems in World War I. The differences were innovations. Instead of "airplane" fuel that supplied the accent of oil research during the first World War the study of jet fuel, begun in 1945, added the fillip to the last one.

For the sound information readily available to a government preparing for war the Division was worth all that had ever been spent for its activities. It had a storehouse of information collected over a period of 27 years of study and research. It was able to give immediate and reliable answers to many of the questions on potential production and refinery capacity that government agencies responsible for national defense needed to know.

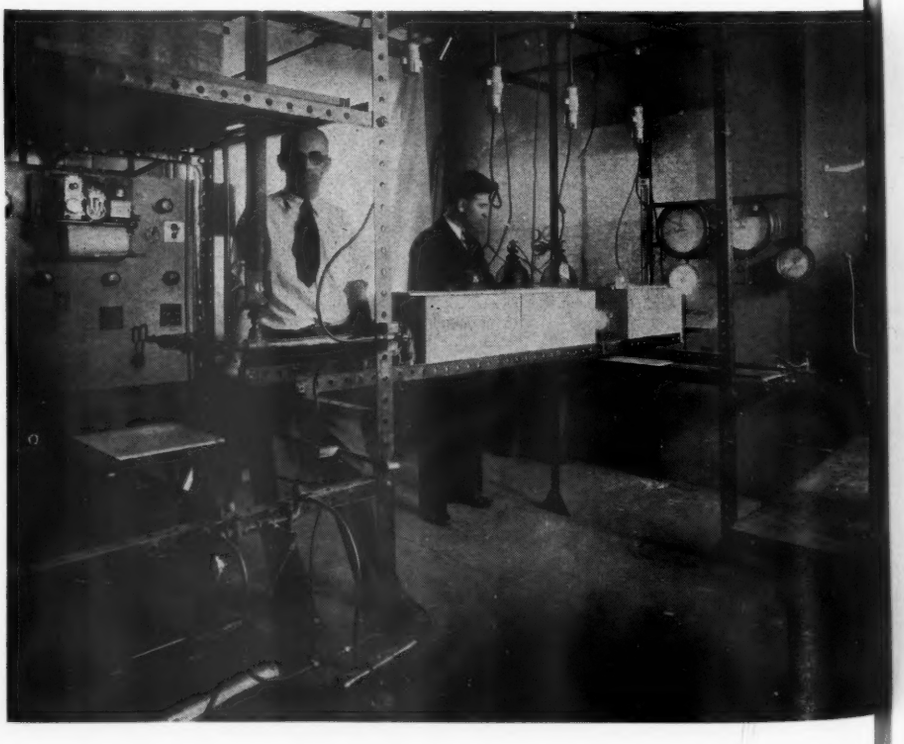
At a time when all steel was needed for war materials, the minimum amount of drilling required to keep production at war strength had to be estimated. The degree of vulnerability to attack because of location of fields and refineries and storage had to be judged and the amount of petroleum production that might be lost had to be figured. The yield and quality of aviation gasoline had to be examined from all angles. The crude oils best suited for the purpose were found, partly from old records, partly by a new survey and sampling project. More helium-bearing gas was needed and new helium plants had to be built to provide the armed forces. The collection of information on explosive qualities of petroleum vapors aided in dealing with fires and explosions and prepared defense against sabotage.

Greater use of mud in drilling was promoted to save steel. The use of secondary recovery methods was advised in marginal fields to add to petroleum supplies.

The Division gave the Army and Navy in the Pacific Theater directions for destroying oil wells and later told them the best methods for restoring wells after the enemy had demolished them.

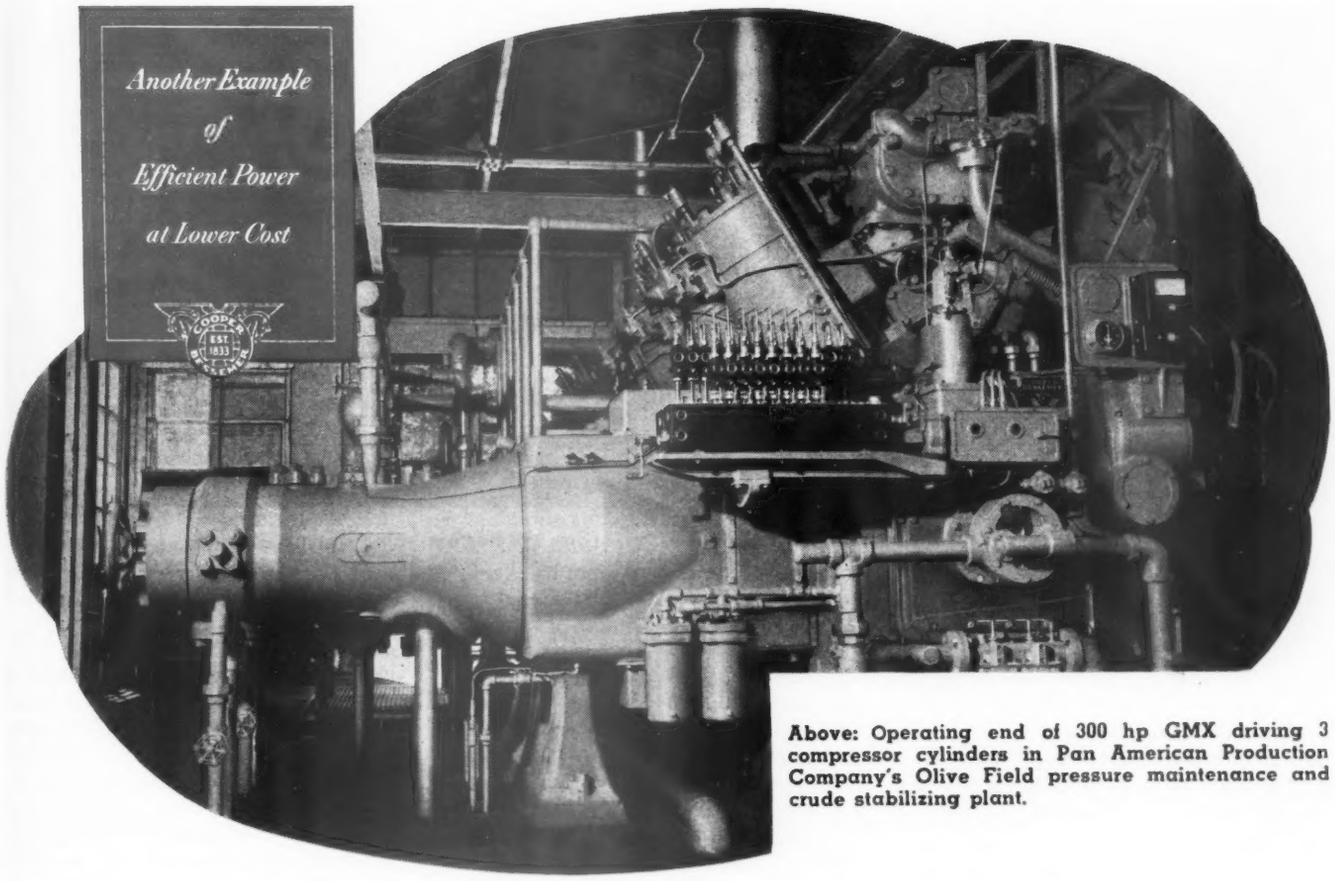
The service of the Division in time of war was invaluable, not only to war agencies but to the operators. Here was a group that the industry knew was well grounded in all its activities. The operators might not agree with the Division's advice but they based their arguments on the same premises, which were founded on the same information. There was understanding of problems to be met in satisfying the tremendous war demand and there was a common interest between the engineers in the Division and those in the industry. The Division was a trusted guide for the

Laboratory for studies in pyrolysis of natural gas in 1930.



*Appendix A and B will be published with Part 4.

Another Example of Efficient Power at Lower Cost



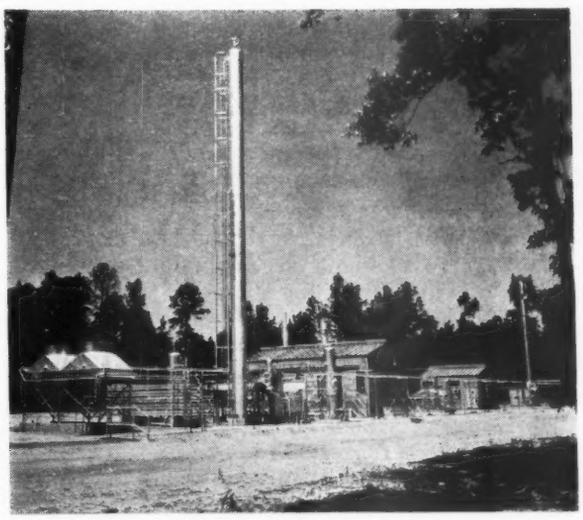
Above: Operating end of 300 hp GMX driving 3 compressor cylinders in Pan American Production Company's Olive Field pressure maintenance and crude stabilizing plant.

"BIG-TIME" compressor performance for small field gas conservation

OLIVE FIELD, TEXAS, rates as one of the smallest fields to utilize pressure maintenance. Here, in Pan American Production Company's pressure maintenance and crude stabilizing plant, two of the smallest Cooper-Bessemer V-angles, Gmx's, meet the compressing needs ideally.

The two units, 200 and 300 bhp, have a combined capacity of 4,166,000 cu. ft. a day. The gas, formerly wasted, is compressed through 3 stages from 250 psi to 4,800 psi injection pressure, all residue gas being returned to the producing formation through a single injection well.

If your plans call for compressor service anywhere from 200 to 2,400 bhp per unit, there are modern, highly efficient Cooper-Bessemer V-angles, GMX's, GMV's, or GMW's, that offer you big savings in the cost of installation, maintenance and over-all, long-range operation.



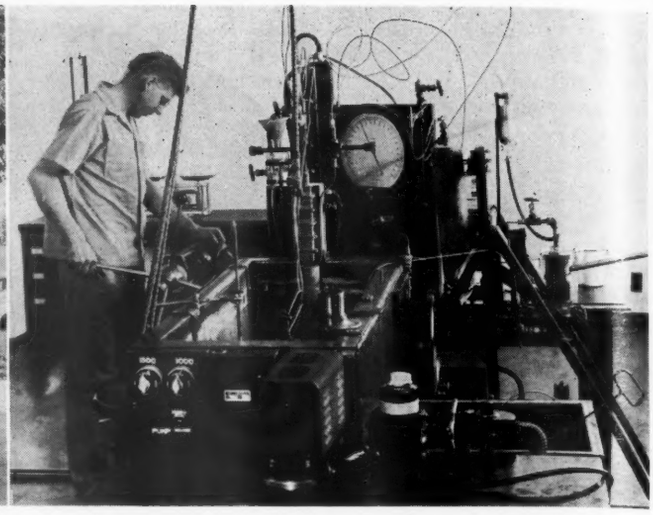
General view of plant. All gas, formerly wasted, is now returned to producing reservoir or used as plant fuel.

The **Cooper-Bessemer** *Corporation*

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York City Washington, D. C. Bradford, Pa. Parkersburg, W. Va.
San Francisco, Calif. Houston, Dallas, Greggton, Pampa and Odessa, Texas
Seattle, Wash. Tulsa, Okla. Shreveport, La. St. Louis, Mo. Los Angeles, Calif.
Caracas, Venezuela Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

From the Laramie, Wyoming, station the above mobile laboratory goes out to do its oil well sampling and testing with the instruments carried in the truck.



Later the bottom-hole oil samples from fields throughout the Rocky Mountain area are brought to the station and analyzed in the apparatus shown above.

government and a proved adviser to the industry. It helped to reach decisions both on petroleum needs and on the best methods for fulfilling them.

Basic Program Maintained. The regular program of the Division was not abandoned for war activities in the 40's. Virtually the entire program already in effect when war appeared was adaptable to war effort. Those dropped were the victims of restricted funds and personnel. The study of natural gas hydrates to aid gas flow in pipe lines, for instance, was being carried on by the Amarillo station but technologists on this work were needed more critically for new helium plants so the gas hydrate research was suspended in favor of work more directly affecting the war.

There was not so much fundamental change, however, as change of emphasis. To maintain an adequate supply of oil and gas the studies of reservoir performance and well spacing became more important than ever before but these were simply an expansion and continuation of the work that Huntley, Arnold, Garfias, and others had begun nearly 30 years before. Research on drilling mud was needed to save steel, to get better cores from a well for tests, to cut production waste, so study of drilling mud was increased during the war; however, Heggim and Pollard advocated the "mud-laden fluid method" of drilling to conserve oil and gas in 1913. Demand for knowledge of properties of hydrocarbons was sharply intensified in order to expedite manufacture of oil products for war, but Allen began analysis of crude oils and Burrell the analysis of natural gas for the Bureau of Mines in 1910.

The value of this continuity of research can hardly be overestimated. The rise and growth of a scientific approach to petroleum operations was embodied in the Division. It had the record of 30 some years study with the aim of more economic and more efficient methods; it had a group heritage of honest purpose and diligent effort. The Division, a solid and experienced organization, was better prepared for its role in war activities than many other parts of the federal government.

Old questions were raised in new forms. The proposal to store liquid petroleum in old reservoirs for protection was brought up. The study of evaporation losses took a new turn with blended products, which might lose more of one component than another, affecting performance. Analysis of crudes under war demand stretched to Cuba's asphalts and to Brazil's new oil field output.

> A complete list of publications on petroleum and natural gas by the U. S. Bureau of Mines is carried in *Petroleum Engineer* Continuous Tables Nos. 139 and 140.

Using a company's commercially successful process, adapted to its experimental needs, the Bartlesville station desulphurized samples of petroleum distillates. The increase in octane number of the desulphurized distillates showed many of them suitable for aviation gasoline base stock, sorely needed at the time. The Laramie Station supplied information on hydrogen sulphide (which is toxic to human beings) to the Elk Basin field operators so that breathing equipment and other precautions would allow continued drilling in the Tensleep sand, where production was 18 per cent hydrogen sulphide gas by volume.

Emulsions and methods of treating them have been on the Division's agenda since Dow began research on sludge pit wastes in the early 20's but it was the war demand for wax that provided the appropriation to build a pilot plant to experiment with processing wax from wastes.

Petroleum War Studies. Establishment of the Franklin, Pennsylvania, office in the Spring of 1942 at the request of Pennsylvania operators, made a new center for secondary recovery research. A laboratory for the project had been set up in Bartlesville in 1924 but it was necessary to rush field application in the face of war demand for petroleum products. Said a Pennsylvania operator: "The (Franklin) office has been seriously handicapped by lack of personnel but has made a sincere attempt to assist and guide the small producer."

In an area with some 15,000 small operators, many of whom receive engineering advice from the Division, the research on air and gas injection and reconditioning of wells is of the utmost importance. Another project that has been studied at this station is the method of horizontal drilling to recover oil from depleted fields.

Bartlesville continued its secondary recovery work, including underground disposal of oil field brines. In 1942 Taliaferro and Logan wrote a history of water flooding in Oklahoma fields, which is being amplified today.

Texas fields attracted much study during the war, resulting in greater knowledge of oil recovery factors and of the influence of spacing on production.

California's heavy oil was needed

to add to fuel supply for war use and the San Francisco office worked on the development of a practical process for recovering bitumen (oil) from outcropping bituminous sandstones.

Continued research on reservoir performance resulted in Miller's pressure-production data and Higgins' study of influence of gas:oil ratios and water saturation, (both 1942).

Analysis of drilling muds brought out the possibilities of protecting an open hole with a sheath of mud, eliminating the necessity of setting casing in many instances and thus saving precious steel casing. Gates and Bowie worked on drilling fluid uses and brought out reports in 1941 and 1942.

This is the barest outline of wartime activities of the Petroleum and Natural Gas Division. The full program it had can only be glimpsed. For instance, here is a more detailed report on one comparatively minor assignment of the Division that can provide a small yardstick for the whole work of the group:

Ralph K. Davies, Deputy Petroleum Coordinator for War, asked R. R. Sayers, Director of the Bureau of Mines on May 9, 1942, to make a confidential survey for his office on the suitability of crude oils and refinery distillates as sources of toluene.

On July 31, 1942, the material had been collected by Division engineers in interviews and correspondence with officials of companies that manufactured toluene and a report was made for the office of the Petroleum Coordinator for War.

Toluene needs increased and on September 3, 1942, the same office requested analyses of a number of condensates for natural and potential toluene. Samples were obtained by the last of September and within two weeks the Bartlesville and Laramie stations analyzed 16 samples of condensate and 2 samples of natural gasoline. The Division, which has had a reputation for deliberate action, moved with becoming speed during the war. The information was used at once in a meeting with toluene manufacturers to promote increased output.

The Division continued to analyze crude oils, condensates, and natural gasoline that might be used to make toluene. A report of the method of analysis was made in April, 1944. This report also summarized results on 107 samples that were examined.

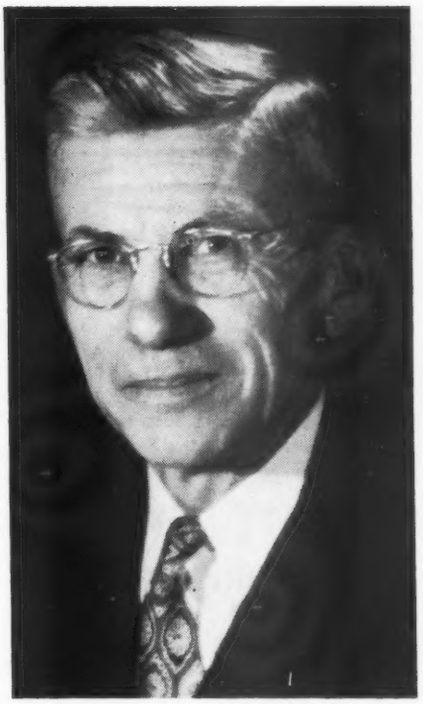
This gives a small idea of the time and effort required for a comparatively simple problem. The toluene project was uncomplicated and proceeded without difficulty. Yet it included an extensive survey, collection of more than 107 samples from all over the United States, development of a standard method of analysis, the testing of each sample by the method, and a complete written report of the results.

This is the type of work, however, for which the Division is well fitted. It could apply its background of knowledge to action that was prompt and efficient. Here again results depended upon the unusual relationship the Division maintains with industry and with the federal government.

The peacetime program, which can more easily be viewed from the present, will be discussed in a concluding article. From present policies and projects the Petroleum and Natural Gas Division can be evaluated. It seems to have accomplished a great deal in the past. Is it fulfilling its original purpose in present highly specialized times? Or has it outlived its usefulness? What course should it follow in the future? Could it produce better results if it were expanded? Reduced?

There can hardly be unanimity of opinion on these questions but we should be able to arrive at some general conclusions with the background of history we now have and a review of the present program.

The fourth and concluding article in this series will be published soon.

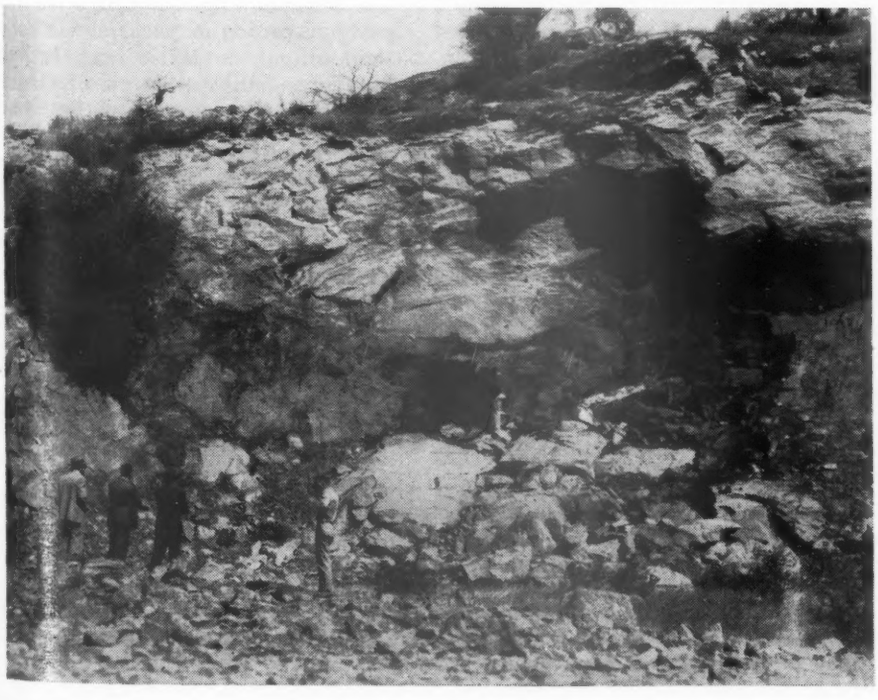


H. C. Miller

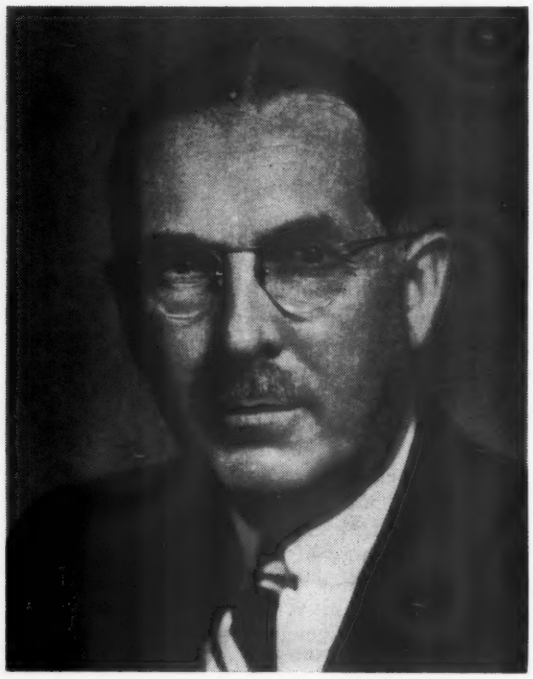
The San Francisco field office of the Bureau of Mines has a competent head in H. C. Miller. An inventor and author as well as a petroleum engineer, he has contributed valuable papers in his long association with the Bureau.

Miller was born in Saginaw, Michigan, and received B.S. and E.M. degrees from the Michigan College of Mines. He went to California in 1911 and worked in engineering and contracting at Bishop until 1920 when he joned Standard Oil of California. He made his connection with the Bureau in 1923 at the San Francisco office and has remained there.

During World War II the San Francisco office developed a process for recovering bitumen from such outcroppings of bituminous sandstone as these to increase the scarce fuel on the West Coast.



Petroleum Profile



CHESTER F. SMITH
of
Standard Oil Company
(N. J.)

CHESTER F. SMITH, in his business and professional career, has shown an outstanding singleness of purpose that has netted dividends in a huge way for him and his company. Born in New Jersey almost in sight of the Manhattan towers at the beginning of the "Gay Nineties" period, he drove through pre-college school in a manner that has become characteristic of him.

A year in the Bayonne laboratory of Standard Oil Company of New Jersey during 1908-9 showed him where he wanted to go; forthwith he started on his way—resigned from his laboratory job and started the mechanical engineering course in University of Pennsylvania. This Alma Mater gave him the Bachelor of Science degree in M. E. Tying in the practical with theoretical and scientific training, he worked each summer vacation period at Bayonne, in 1910, 1911, and 1912. With a spanking new sheepskin he rejoined the permanent staff of Standard Oil at Bayonne in 1913, again in the laboratory.

But Smith hankered to deal with barrels, not cubic centimeters, of crude oil. He wanted to run a 10,000 bbl still, more than a 100 cc 'Engler' analytical distillation, so he started in that direction. In 1915 he was made superintendent of Can and Case Operations at Bayonne, supervising the packaging of finished products, and served a Biblical "seven years" in this capacity. Refining technology was expanding at a terrific pace during these times, as was the capacity and output of the Bayonne plant. The general superintendent needed an assistant to help in handling his always increasing duties; he selected young Smith from the canning plant as his understudy and in 1926 the assistant became the general superintendent at Bayonne.

Destined for high places, Smith reached his present level through the stepping stones of Bayonne manager, assistant general manager, and then manager of the three New Jersey refineries. With the latter job he was made vice president and a director of what is now Esso Standard Oil Company on July 1, 1933, in charge of all manufacturing for the company. The depression of the 1930's was on and he had the onerous job of keeping the company's manufacturing operations out of the red during a period of falling prices, lowering market demand, and rapidly expanding refining technology.

Many of the refining processes, which have become all-important in the manufacture of better petroleum products, were developed or well started in research during this pre-World War II period of 1933-42. Solvent extraction of lubricating oils; hydrogenation of heavy products, in which Jersey interests took a leading part; alkylation of paraffins via catalytic action; catalytic cracking of heavy fractions; synthesis of chemicals from petroleum gases. Standard made the first synthetic alcohol from still gases (olefins) and we saw the amazing anomaly of an American firm shipping alcohols to Germany, hitherto the leading chemical center of the world.

One hundred octane number aviation fuels were becoming commonplace in the laboratory and the test field, using the superproducts from the new processes and laying the groundwork for the wartime military aviation the most remarkable large development of the War.

Elected Standard of New Jersey president in 1940, he piloted the company's wartime destinies until 1944, when he was made a director of Standard Oil Company (New Jersey) and two years later became its vice president.

NEWS

NPC Proposes National Oil Policy

At its first meeting of the new year, the National Petroleum Council, recommended a national oil policy in a report from a 24-man committee, headed by A. Jacobson, president of Amerada Petroleum Corporation.

The recommendations included:

1. Federal government should stay out of the synthetic fuel field, except for fundamental research and surveys of raw material reserves.
2. Title to tidelands should be restored to the various states.
3. Government should stockpile only enough oil for early stages of war; peace-time stockpiling is unnecessary and impractical.
4. Industry should be assured an adequate supply of essential materials.
5. Participation of Americans in development of world oil resources "is in the interest of all nations."
6. Foreign oil should be available to the United States as needed, but not in such amounts to retard or hamper the domestic industry.
7. Government should confine itself to safeguarding the public interest, and should encourage private capital by "appropriate tax provisions and public land policies."
8. No government actions, specifically affecting the oil industry, should be taken without consultation with the industry.
9. Government should restrict its natural gas jurisdiction to interstate commerce, and not invade the field of producing, gathering, or processing.
10. Government should continue federal tax deductions for depletion and for intangible drilling, geological, and geophysical expenditures.
11. Revise minerals leasing act, release acreage restrictions, and provide management control to the lessees of public domain.

H. F. Sinclair Resigns

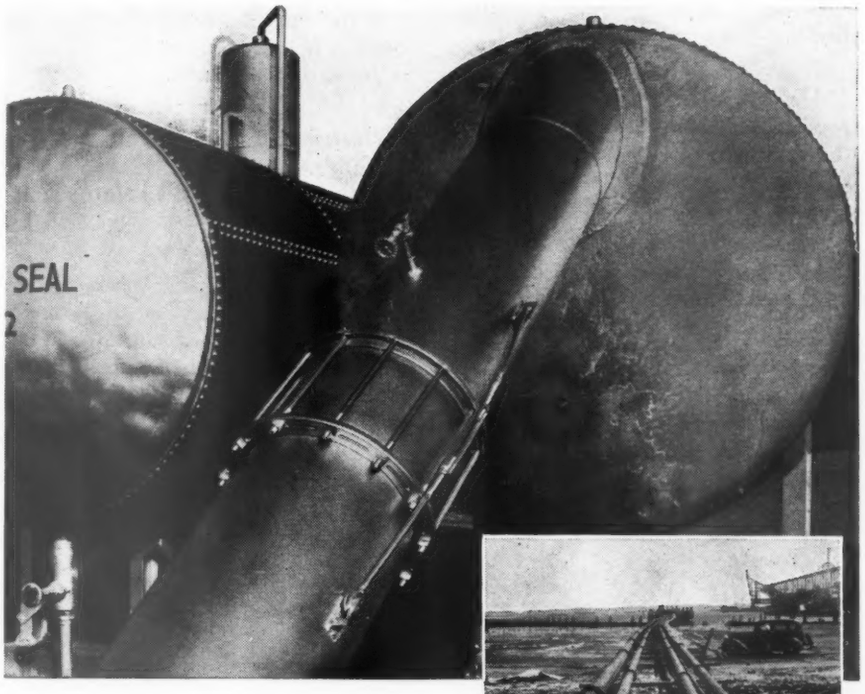
Harry F. Sinclair, founder and for 33 years chief executive of Sinclair Oil Corporation, has resigned as president and been elected chairman of the board of directors. He is succeeded by P. C. Spencer, who has been president of the company's principal operating subsidiary, Sinclair Refining Company.

Sinclair said that he desired to be relieved of active direction of operations now that the corporation's $150,000,000 expansion program was nearing completion.

E. DeGolyer and Lewis MacNaughton, *Dallas, were awarded honorary memberships for distinguished service in a geological capacity at a recent meeting of Dallas Nomads. Here DeGolyer receives parchments from Brad Mills, president of the chapter. MacNaughton was unable to attend.*

At the same meeting, Jim Herrick, Cardwell Manufacturing Company, Wichita, Kansas, spoke and showed pictures made on a trip extending from Labrador to the Hawaiian Islands, via England, France, Italy, Greece, Saudi Arabia, and the Malayan region.

HANDIEST... wherever you have pipe to join



Whether it's an equipment hookup, a field line, or a terminal—anywhere you're joining pipe—the handiest, surest way to get uniformly tight pipe joints is with Dresser Couplings and Long Sleeves.

There's no pipe threading—the only tool you need is a wrench. Dressers give you a "Flexible-Tight" connection every time, day or night, rain or shine, even where pipe ends don't meet.

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LAUGH WITH BARNEY

"Mama, if I get married will I have a husband like Daddy?"

"Yes, dear."

"And if I don't get married will I be an old maid like Aunt Minnie?"

"Yes, dear."

"Mama, it's a tough world for us women isn't it?"

" " "

"What foah dat doctah comin' out to youah house?"

"Ah don' know, but Ah thinks Ah has a little inkling."

" " "

"How do you feel after your ride on that horse?"

"Gosh! I never thought anything filled with hay could be so hard!"

" " "

"About this girl you want to marry; has she good connections?" asked a proud mother.

"Well, she never came apart when I was with her," replied the sailor.

" " "

She: Sometimes, my dad takes things apart to see why they don't go.

He: Yeah?

She: Yeah. So you'd better go.

" " "

Don't excuse yourself by saying that people must take you as you are.

Frosh: Hi, ya, cutie. I'm going your way."

Gal: "Oh yeah! Better bring your powder puff then."

" " "

Two ladies who had not seen each other for a long time met on the street.

"Oh! Mary," Blanche excitedly exclaimed, "I've had a lot happen to me since I saw you last. I had my teeth out and an electric stove and a refrigerator put in!"

" " "

Girdle Gossip: One girdle manufacturer just got sent up the river for a two-way stretch.

" " "

Wife (to the late returning husband): Is that you, John?

John: It'd better be.

" " "

Husband: I miss the old cuspidor since it's gone.

Wife: You missed it before. That's why it's gone.

" " "

Life isn't fair to men. When they are born their mothers get the compliments and flowers; when they get married their brides get the presents and publicity; when they die their wives get the insurance and the winters in Florida.

When Pat and Mac registered they had to sign their names and nationality.

Pat signed: Irish—and proud of it.

Mac signed: Scotch—and fond of it.

" " "

Grandson: Grandpa, was Tee Lee, the robber they sing about, a Chinaman?

Grandpa (puzzled): Tee Lee, what song is about him?

Grandson: Oh, grandpa, you know that song—"Waiting for the robber Tee Lee."

" " "

"Tommie Hagan will not be in school today."

Teacher: Who is this speaking please?

"This is my father speaking."

" " "

Father Kelly and Rabbi Levi were seated opposite each other at a banquet where some delicious roast ham was served, and Father Kelly made comments upon its flavor. Presently he leaned forward and addressed his friend.

"Rabbi Levi, when are you going to become liberal enough to eat ham?"

Retorted the Rabbi, "At your wedding, Father Kelly."

" " "

The two worst wolves in the world are Chase and Sanborn. They date every bag.

" " "

Have you heard about the cross-eyed professor who couldn't control his pupils?

" " "

An efficiency expert walked into an office and asked the first clerk he met, "What do you do here?"

"Nothing," answered the clerk, who was obviously getting tired of efficiency experts.

The efficiency expert nodded, made a note, then asked a second clerk, "And you, what's your job here?"

"I don't do a thing either."

"H m m m m," said the efficiency expert, "duplication."

" " "

No wonder mental diseases are on the increase. Anybody can be driven crazy by high prices and low skirts.

" " "

"Just think of it!" exclaimed the romantic young newlywed, "a few words mumbled over your head and you're married."

"Yes," agreed the old cynic, "and a few words mumbled in your sleep and you're divorced."

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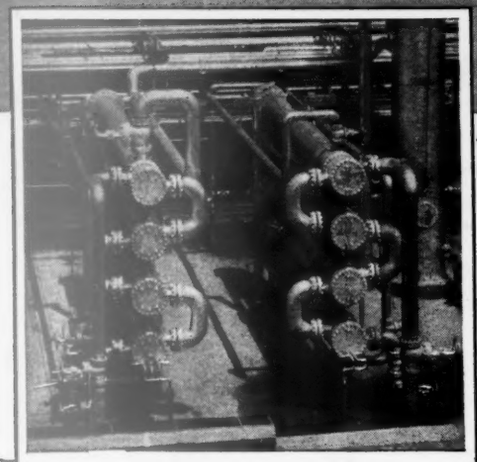
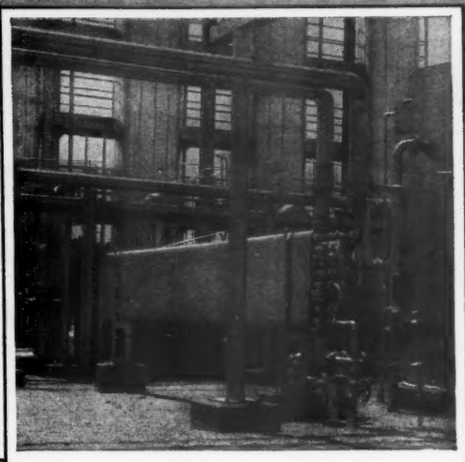
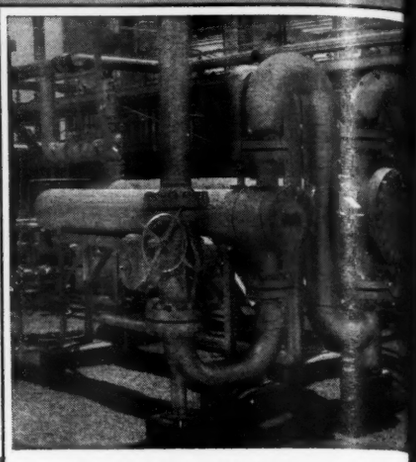


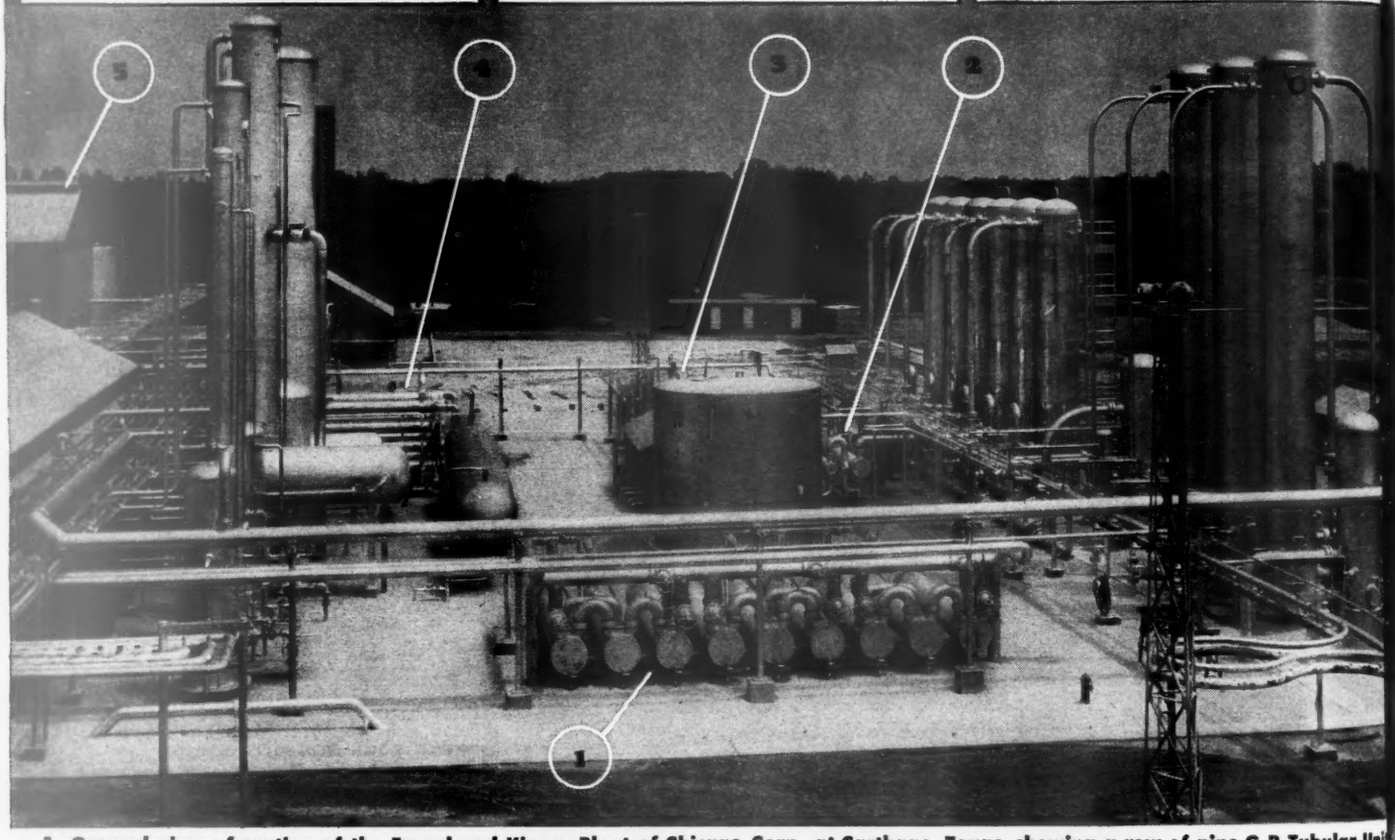
4. G-R Tubular Still Feed Exchangers and Preheaters



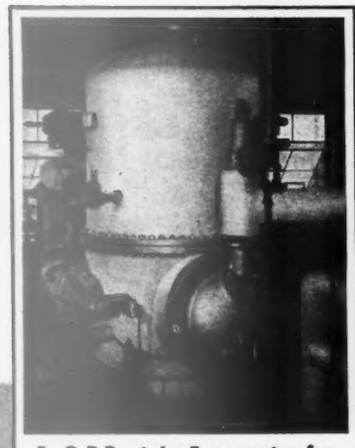
3. G-R Twin Bare Pipe Section Boiler Feedwater Exchangers



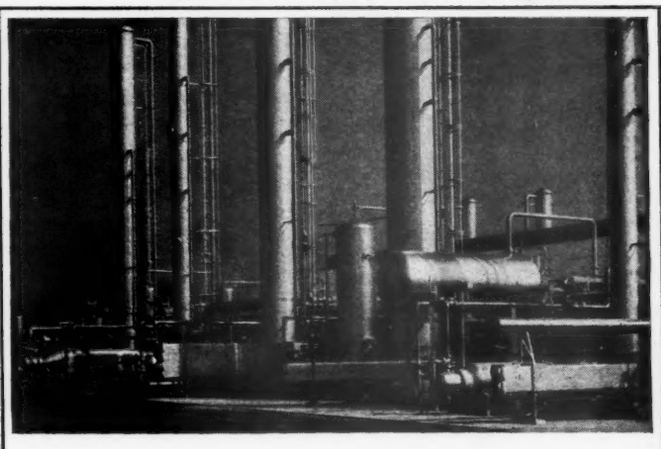
2. G-R Tubular High-Pressure Gas Heaters for regeneration of dehydrating material



1. General view of portion of the Feasel and Kinsey Plant of Chicago Corp., at Carthage, Texas, showing a row of nine G-R Tubular Uni used as main exchangers in the foreground



5. G-R Bentube Evaporator for distilling the feedwater make-up for the high-pressure boiler plant



G-R Kettle Type Reboilers and G-R Twin G-Fin Section Fractionator Column Feed to Product Exchangers

Two of more than 60 G-R Atmospheric Bentube Sections for all cooling services, including extremely high-pressure gas cooling

GRISCOM-RUSSELL: PIONEERS IN HEAT TRANSFER APPARATUS

G-R

Heat Transfer Apparatus

again used in this Chicago Corporation Plant

The Chicago Corporation has had lengthy experience with G-R Heat Exchangers . . . they have successively installed many G-R units of various types at their Wardner, Coastal and Gulf Plains Recycling Plants.

The excellent performance of these previous G-R installations has justified their continued use of G-R Heat Transfer Apparatus throughout the new Chicago plant at Carthage, Texas. Here, as shown in the illustrations, a total of more than 100 G-R units of the following types have been installed:

Atmospheric Bentube Sections
High-Pressure Gas Heaters
Tubular Exchangers
Kettle Type Reboilers
Twin G-Fin Sections
Twin Bare Pipe Sections
Bentube Evaporator

This installation indicates two significant points of importance to *every* user of heat transfer apparatus:

1. The many different types of G-R equipment . . . an exactly suitable design for every heat transfer requirement
2. The outstanding success of G-R installations . . . winning repeat orders and exclusive standardization on G-R equipment

Bulletins describing G-R apparatus for heat transfer services in which you are interested will be sent on request.

THE GRISCOM-RUSSELL CO.

285 MADISON AVENUE, NEW YORK 17, N. Y.

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GRISCOM-RUSSELL

AIME Meets in San Francisco

The Petroleum Division of AIME has scheduled four sessions and a dinner for the annual meeting being held this month in San Francisco. On the program are reviews of domestic and foreign production, touching upon highlights rather than detailed statistical material.

The Division's Certificate of Service Award is being presented to F. Julius Fohs of Houston, Texas, and to J. B. Umpleby of Dallas, Texas.

Lloyd Elkins of Tulsa, Oklahoma, succeeds I. W. Alcorn of Houston as chairman of the division.

Titus Hose Dies

Titus Sheard Hose, 58, petroleum engineer, died at his home, Shagroy Farm, Millerton, New York, November 24. He was with the Standard Oil Company of New York in China before the first world war and later with the Anglo-Persian Oil Company.

New Sales and Service

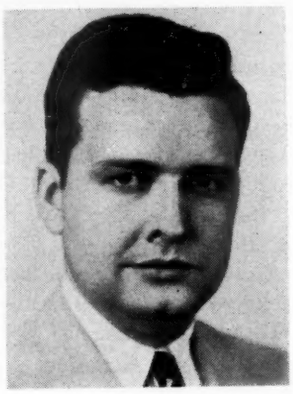
D. C. (Clint) Walker has announced that he and W. H. (Pete) Petross have formed the firm of Walker Oil Well Specialties Company with headquarters at 1312 Hunt Building, Tulsa, Oklahoma. They will handle the sales and service accounts of Rector Well Equipment Company, Inc., Culp Engineering Company, and B and W, Inc. Stocks of Rector equipment and B and W, Inc., equipment will be carried at Oklahoma City and service on "Culp-Lap" patented plug and gate valve repairing will be maintained at Tulsa and Oklahoma City.

D. C. Walker *W. H. Petross*

Both Walker and Petross recently resigned from Hinderliter Tool Company Division, H. K. Porter Company, Inc., after about 9½ years service.

Stanolind Executives Named

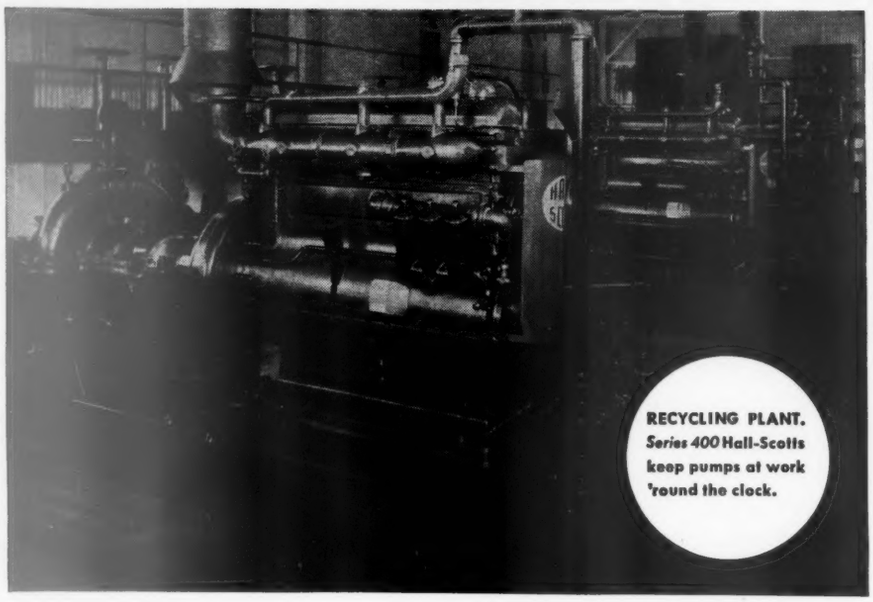
John E. Swearingen has been named executive assistant to J. E. Rouse, vice president in charge of operations for Stanolind Oil and Gas Company. Swearingen succeeds Lewis Finch, Jr., who has been transferred to Fort Worth as division engineer. Swearingen joined Stanolind as a project engineer in April, 1947, and has served in various capacities in the manufacturing department. He received a BS degree in chemical engineering from the University of South Carolina, 1938 and an MS from Carnegie Institute of Technology, 1939.



John E. Swearingen

Heads ASME Committee

Frank S. G. Williams of New York, eastern manager of Taylor Forge and Pipe Works, has been appointed by American Society of Mechanical Engineers as chairman of ASA sectional committee B-31, which is responsible for the American Standard Code for Pressure Piping.



VERSATILE PERFORMER

in oil field, pipe line, and refinery!

For dependable power for pumps, generators, drilling rigs, draw works, booster equipment, power stations... get *Series 400* Hall-Scott Engines! Delivering high torque at low r.p.m., Hall-Scott Engines require minimum attention, keep maintenance costs down. They'll burn butane, natural gas, or gasoline. Complete data on request.

HALL-SCOTT

MOTOR DIVISION

ACF-BRILL MOTORS COMPANY

Factory and Main Office: Berkeley 2, California

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THE NEW FLEXARC RANGER

GETS THERE FAST...

ANYPLACE...ANYTIME

A SMALLER, LIGHTER
ENGINE DRIVEN WELDER
PORTABLE OR SKID-MOUNTED

YOU CAN BE SURE IF IT'S Westinghouse

You'll find the answer for tough field construction and maintenance jobs in this new Flexarc Ranger. The Ranger goes to work anywhere, anytime . . . travels faster, farther, over rougher terrain . . . works in places inaccessible to larger, heavier equipment. It trails along at highway speeds . . . produces "shop" welds where electric power is not easily available. Yet, the Ranger equals big-welder efficiency at lower operating costs.

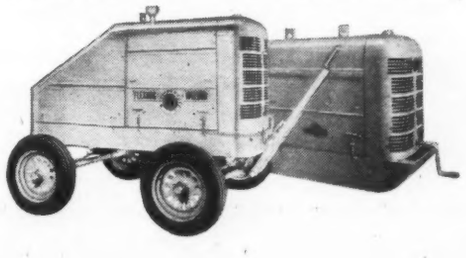
Powered by a 4-cylinder Hercules industrial engine, the Ranger has a rating of 200 amps, 30 volts, 50% duty cycle, with a welding current range of 30 to 250 amperes. 2-wheel, spring-mounted, pneumatic-tired, standard road gauge running gear permits towing at high speed. Welder comes complete, with all essential accessories.

For full details on the Ranger and other Flexarc A-C Welders, call your nearby Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-21467

Westinghouse Heavy-duty Engine-driven Welders

This husky welder is built for hard, continuous service wherever electric power is not available. Single, preset current adjustment gives the exact welding current desired without drop-off. Gasoline or diesel engine operated . . . available in 200, 300 and 400-ampere ratings . . . supplied with either bedplate or wheels.



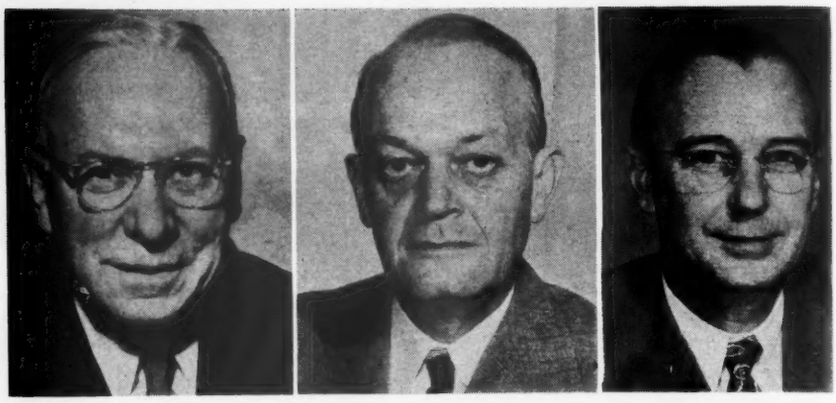
Westinghouse FLEXARC
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE
WELDERS AND ELECTRODES

PERSONALS

H. J. Struth, veteran oil economist and analyst, has joined the staff of the American Petroleum Institute in New York as head of the Research Section in the Department of Information. He resigned the editorship of The Petroleum Data Book, a publication of The Petroleum Engineer Publishing Company, Dallas, Texas, to accept the position with the API.

H. J. Struth

Struth has been in the petroleum industry for 31 years. Prior to his editorship of The Petroleum Data Book, he spent 10 years with the Mid-Continent Oil and Gas Association as an economist and administrative assistant. During the NRA days he served in Washington as technical adviser to the Petroleum Administration.



A. D. Simpson *R. P. Doherty* *E. O. Buck*

Clifford W. Lord has been elected vice president of United States Steel Supply Company, U. S. Steel subsidiary, according to an announcement by L. B. Worthington, president. Lord will be in charge of the company's warehouses on the Pacific Coast.

H. D. "Judge" Foster, manager of the mechanical goods division of the Goodyear Tire and Rubber Company, was presented with a service pin recently in recognition of his 35 years of continuous service with the company. He was named to his present post in June, 1947, succeeding the late W. C. Winings.

R. P. Doherty, who has been connected with the National Bank of Commerce, Houston, Texas, for more than 30 years and who has been executive vice president since 1934, became president of the bank when **A. D. Simpson,** former president was elevated to vice chairman of the board. Jesse H. Jones is board chairman.

E. O. Buck, manager of the oil loan department of the National Bank of Commerce for the past year, was named a vice president. During the war years Buck served as director of production for PAW, District 3. He has been associated with the oil industry since 1926. He resigned as southern manager of Rowan Drilling Company to join the bank.

Fred W. Mill

Fred W. Mill became division controller of The National Supply Company, Torrance, California, on January 1, according to an announcement by E. H. Thorsteinson, vice president and controller. Mill takes over the duties of **A. E. Witt,** who upon retirement December 31, completed 32 years service. Witt remains with the company in an advisory capacity.

George H. Shumaker has been appointed manager of the Michigan district for The National Supply Company. Shumaker will make his headquarters at Mt. Pleasant, Michigan. **H. H. Tschappat** has been made assistant district manager.

Dependability
WHEN IT COUNTS!
Standing ready to furnish emergency lighting at a Cheney, Kansas oil field for a large products pipe line company.
HEAVY-DUTY
WISCONSIN Air-Cooled ENGINES
Whether pumping oil hour after hour, summer and winter — or "standing by" ready to deliver instantly electric light and power, when the high line power fails . . . both oil men and manufacturers of equipment know that they can place complete reliance on Wisconsin power.
Every Wisconsin Engine, 2 to 30 hp., runs on Timken tapered roller bearings . . . is constructed for heavy-duty service . . . operates with a minimum of maintenance . . . is free from cooling troubles! You can't go wrong when you specify Wisconsin Heavy-Duty Air-Cooled Engines!
4-cycle, single-, two-, and four cylinder models.
WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines
WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.

James S. Weaver has become associated with Culbert Pipe and Fittings Company as special sales representative in the New York territory.

W. H. Tonn has been added to the staff of the Second National Bank of Houston. He will act as assistant to **C. Cabanne Smith** in the Industrial Engineering Department which is concerned with gathering accurate, factual data on Houston industry and preparing industrial surveys for bank customers and prospective customers. A graduate of the University of Texas, Tonn was also research associate and consultant at Massachusetts Institute of Technology, and was associate professor at the University of Oklahoma.

George F. Mitchell, president, The Peoples Gas Light and Coke Company, Chicago, has been appointed chairman of the 1949 convention committee of the American Gas Association, it was announced today by **Robert W. Hendee,** president of the association and president of Colorado Interstate Gas Company. **F. X. Mettenet,** vice president, The Peoples Gas Light and Coke Company, will serve as vice chairman of the committee which will direct overall arrangements of the 31st annual convention of AGA, to be held in Chicago, October 17-20, 1949.

E. H. Short, Jr.

E. H. Short, Jr. has been appointed chief engineer of the equipment division for Mud Products, Inc. of Tulsa, Oklahoma. Short has a broad background of experience in many phases of the oil industry. From 1925 until 1934, he was associated with the Gulf Oil Corporation, Tulsa. He gained a reputation as a widely read and authoritative writer of drilling and production operations in 1943 when he joined the Houston editorial staff of the *Oil and Gas Journal*. After leaving the *Journal* and prior to his present position with Mud Products, Short was associated with the Frank Dyke Advertising Agency, Houston.

Fred A. Davies' election as executive vice president of Arabian American Oil Company has been announced by W. F. Moore, Aramco president. Davies has been associated with Aramco since the earliest days of the company's activities in the Persian Gulf area. A mining engineer and oil geologist by profession, he was among the first to suspect the presence of oil in Saudi Arabia. Since 1947 he has concentrated on an expanded production and exploration program as vice president in charge of those departments.

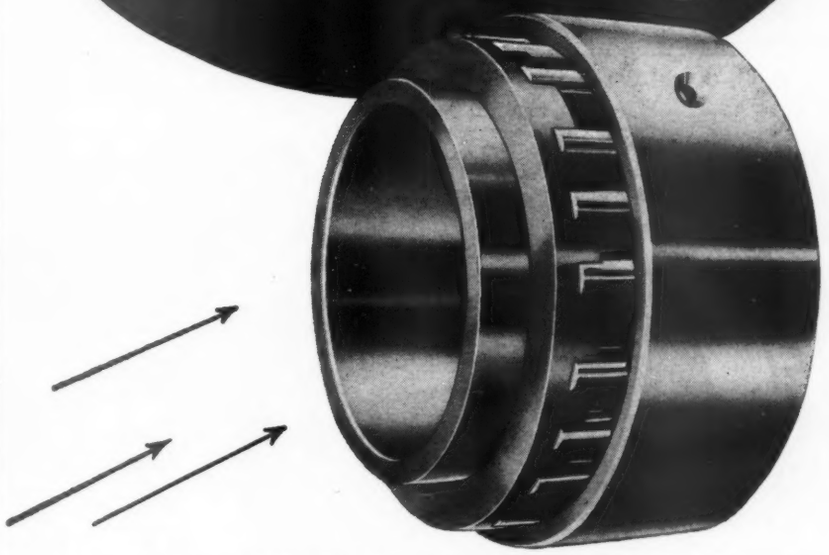
As a companion move to the Aramco Board of Directors' action, the Board of Trans-Arabian Pipe Line Company elected Davies a vice president. In that capacity he will coordinate Aramco and Tapline government relations activities in the Middle East.

A. W. Hair has been appointed accounting and office coordinator for the central region of Socony-Vacuum Oil Company, Inc., the company has announced.

Hugh H. Hurst has been made central manufacturing accounting and office coordinator. Hair is responsible for all accounting activities in the central area with Hurst reporting to him. Offices are in Chicago.

Gluttons for punishment

American
Heavy-Duty
Roller Bearings



Designed especially for "tough going," AMERICANS have what it takes to render smooth, dependable service in heavy industrial applications. Strong, precision built, longer lasting, they will minimize your anti-friction bearing problems. Our technical staff will assist you in selecting the right bearings for your needs. Write.

AMERICAN ROLLER BEARINGS HEAVY DUTY

AMERICAN ROLLER BEARING CO.
420 Melwood Street Pittsburgh, Pa.

Pacific Coast Office: **1718 S. Flower St., Los Angeles, Calif.**

John Post has been appointed manager of Continental Oil Company's new industrial relations department, announced company president, L. F. McCollum. Formerly manager of the employe relations department of Standard Brands, Inc., New York, Post joined Continental on February 1, and will direct the company's personnel, labor relations, safety, pension, insurance, health, credit, union, recreation and other employe benefit proprograms.

Born in New York City in 1912, Post is one of the youngest industrial relations managers of a major industry in the United States. He received his B.S. degree at Columbia University in 1933, and his law degree from the same school in 1936. Prior to joining Standard Brands, Inc., in 1944, he was associated with the Allied Chemical and Dye Corporation, and with a New York law firm.

George E. Ziegler and **Clayton O. Dohrenwend** have been appointed director and assistant director of the Midwest Research Institute. The announcement followed the annual trustees' meeting held in December 1948, in Kansas City, Missouri. Ziegler came to the Institute at the time of its inception in 1945 as executive scientist, having previously been associated with Armour Research Foundation in Chicago. He is known in scientific circles for his experimental X-ray diffraction studies and has numerous publications and patents to his credit.

Dohrenwend has been research consultant since coming to the Institute in 1946. He was formerly associated with Illinois Institute of Technology as director of the mechanics department.

Frank Richardson has been appointed assistant to the vice president of oil production and pipe line and **F. E. Steele** has been advanced to the post of general superintendent of oil production, the Lion Oil Company has announced.

F. S. Clulow and **C. S. Gentry** who have held executive positions with Shell Oil Company for many years, have been appointed directors, it was announced by H. S. M. Burns, president of the company. Clulow is vice president in charge of manufacturing and Gentry is vice president and general counsel.

E. C. Peet, formerly vice president and treasurer for Shell Oil east-of-the-Rockies, has been named financial vice president in charge of the company's financial organization from coast-to-coast. He also was appointed a director of the company. Other changes in the Shell financial organization result in **J. H. White,** vice president in San Francisco, moving to New York as vice president and controller, and **A. G. Schei,** treasurer of Shell Chemical Corporation, becoming treasurer of Shell Oil. White will have responsibility for all accounting, auditing, and tax functions; and Schei will supervise banking, credits, insurance, payrolls, and office services.

A. A. Buzzi, formerly assistant treasurer, has been named assistant controller, and **J. M. Flaherty,** formerly manager of the accounting department, becomes assistant treasurer.

L. L. (Len) Walker has joined Champion and Smith, Inc., export representatives, as manager of Canadian operations. His permanent headquarters will be in Edmonton, Alberta. Walker has had wide experience in the oil industry, having at one time been general drilling superintendent for Shell Oil Company and its subsidiaries. He resigned as manager of B & W, Inc., to accept the Canadian assignment.

William Alexander Dean, 83, an officer in Great Expectations Oil Corporation, and father of Paul C. and David P. Dean, died in Fort Worth, Texas, his home, on January 20, 1949.

DEAN BROTHERS PUMPS INC. INDEANAPOLIS PUMPING MACHINERY INDEANA.

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

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PUMPS

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

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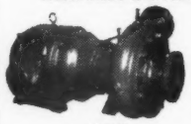

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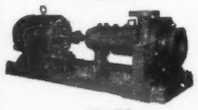

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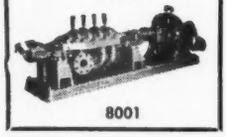

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RECIPROCATING

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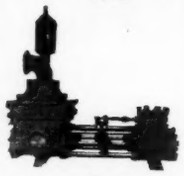

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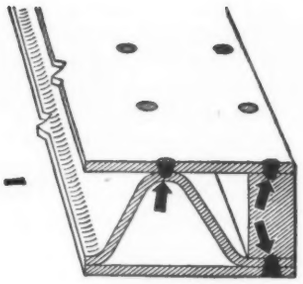
BRANCH OFFICES: NEW YORK HOUSTON

IN PLACES LIKE THESE?



Full Scale

"HELIARC" TORCH SPOT WELDING can do it easily and quickly

Torch spot welding is a new use for inert-gas-shielded arc welding that fills a long-felt gap in sheet metal assembly methods. Spot welds are made by a light pistol-grip torch that requires access to the work from only one side.

Does many jobs

You can use this new HELIARC torch for many types of spot welding work. It is especially useful where the structure is large or of complicated shape because welding is done from one side and no forging pressure is required. You can spot weld ducts, tubes, containers, brackets, handles and many other assemblies. Mild steel, low alloy or stainless steel .030 to .064 in. thick are the metals that can now be welded. Not only can you join sheets of these metals in one to two seconds per spot, but you can also join a sheet of metal to underlying material of any thickness. Thus, corrosion resistant sheets can be spot welded to mild steel plate to provide cladding.

Easy to use

It's no trick to weld with the pistol-grip HELIARC HW-8 Spot Welding Torch. Just press the "muzzle" of the "gun" against the work and pull the trigger.

Low-cost power equipment is another feature of this process that makes it attractive. A regular 300 amp. welding transformer with high frequency unit is all that is needed to supply the power. Power return is by ground lead clamped to the work at any convenient location. A timer control automatically takes care of operating the accessory equipment.

Equipment is simple

Only one hose assembly connects the torch to the accessory equipment which can thus be placed out of the way to leave the entire work area free. The standard hose assembly is 25 ft. long. The hose is about an inch in diameter and contains conductors for power cable, cooling water, shielding gas, and trigger control. Electrode adjustment is easily made by push-button control located on the torch. All of these features make the spot welding torch easy and natural to use and as light and portable as an oxy-acetylene blowpipe.

The ease of use and quality of work done with HELIARC torch spot welding makes it an ideal production line tool. Contact any LINDE office for additional information about this new spot welding process.

The words "Linde" and "Heliarc" are registered trade-marks of The Linde Air Products Company.

Linde
Trade-Mark

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities
In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto

John C. Agnew has been elected secretary and treasurer and a director of Sun Oil Company, according to an announcement by president Robert G. Dunlop on behalf of the board of directors. Agnew, who has been assistant secretary and assistant treasurer since June, 1947, succeeds **Francis S. McIlhenny, Jr.**, who resigned last month.

Agnew played a prominent role in the development of the stock purchase plan for Sun employes which became effective in 1926. He was in charge of the accounting of the plan for many years and has been one of three trustees of the plan since 1944.

Reese H. Taylor, president of the Union Oil Company of California, has been elected president of the Western Oil and Gas Association. Taylor succeeds **Ralph B. Lloyd,** president of Lloyd Corporation, Ltd., who headed the association for the past seven years.

All other officers were re-elected by the board of directors. They included **William Reinhardt,** vice president of the Union Pacific Railroad Company, first vice president; **William F. Humphrey,** president of Tide Water Associated Oil Company, second vice president; **L. K. Whittier,** vice president of Belridge Oil Company, treasurer; **John M. Pierce,** executive secretary; and **D. S. Kilgour,** secretary.

Ten new directors were elected. They are: **L. L. Aubert,** president of the Bankline Oil Company; **C. E. Boone,** manager of the California division of Amerada Petroleum Corporation; **H. A. Eklund,** vice president of British-American Oil Producing Company; **R. E. Havenstrite,** Operator; **M. A. Machris,** vice president of Wilshire Oil Company; **Thomas W. Simmons,** president of Bolsa Chica Oil Corporation, and **W. W. Valentine,** president of Fullerton Oil Company, all of Los Angeles; **Allen A. Jergins,** vice president of Jergins Oil Company, and **Will J. Reid,** president of Hancock Oil Company, both of Long Beach, and **P. E. Lakin,** executive vice president of Shell Oil Company, San Francisco. Twenty-two incumbent members of the board were re-elected.

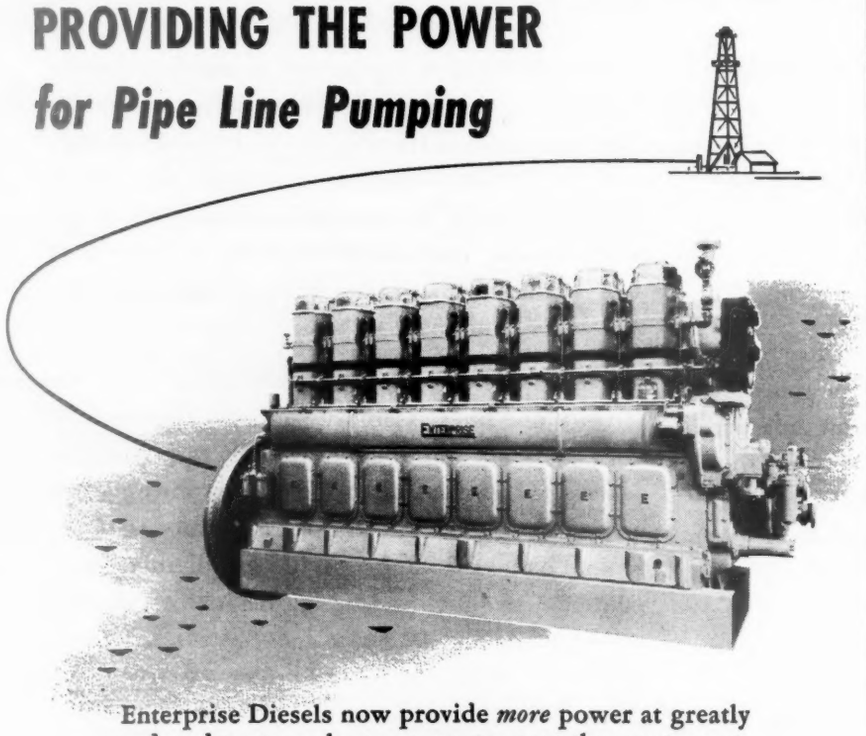
C. L. McNeese, of the Houston Lighting and Power Company, was elected president of the Petroleum Electric Power Association for the next year; **J. B. Moore,** of the Northern Indiana Public Service Company, Hammond, Indiana, is vice president, and **N. W. Beaudeau,** of the Central Power and Light Company, Corpus Christi, is secretary-treasurer.

At the meeting, **W. H. Stueve,** of the Oklahoma Gas and Electric Company, was awarded a certificate for outstanding work in behalf of the association for the past twenty years.

Frank J. Whelan

Frank J. Whelan, a vice president of Worthington Pump and Machinery Corporation with headquarters at the company's executive offices at Harrison, New Jersey, will supervise the sale of welding positioners and turning rolls manufactured at the corporation's Dunellen Works. He will continue to supervise the sale of Worthington's standard pumps, compressors, and mechanical power transmission equipment sold through industrial and oil field distributors, as well as sales to original equipment manufacturers.

PROVIDING THE POWER
for Pipe Line Pumping



Enterprise Diesels now provide *more* power at greatly reduced cost per horsepower to meet the most exacting demands required in pumping service. Substantial economies are offered through 1) simplicity of connection and control, 2) high torque at all speeds, and 3) elimination of transmission losses. They are designed and built to withstand heavy punishment from excessive pumping loads. Smooth, even, vibration-free operation is characteristic of this precision equipment.

Whatever your pumping power requirements, check Enterprise Diesels first. You'll find them flexible to your needs, using Diesel oil, modified crude oil, natural gas or dual-fuel. Normally aspirated or turbo-charged up to 1800 HP per unit. Write or call for information on your particular power problems.

Builders of Heavy Duty Engines and Equipment Since 1886

ENTERPRISE Diesels

ENTERPRISE ENGINE & FOUNDRY CO.
18th and Florida Streets • San Francisco 10, California
With Branch Offices in Houston and Fort Worth Serving the Oil Industry

NEW DEEP HORIZONS

THE ARTICLE about today's deep wells that appears in this issue of The Petroleum Engineer is evidence of the practical and scientific persistence of modern oil operators in exploring for new producing fields deeper than 12,000 ft. It is not surprising to those familiar with Nature's thick sedimentary basins that such explorations are opening many new fields and reservoirs. It should be surprising to many, however, that the average cost of drilling deep wells in 1948 was about 8 per cent less than in 1947.

Part of this reduction in cost (in the face of higher prices for equipment and services) is probably due to the fact that 12,000 to 14,000-ft wells are no longer novel in many areas such as the Gulf coast and California. Powerful rigs, heavy tools, tough bits, and modern methods enable operators to reach these depths with more ease and in a shorter time than it took to reach 10,000 ft ten years ago. One development well in the Louisiana Gulf Coast, for example, was drilled deeper than 12,000 ft and completed as a dry hole for less than $100,000. Wildcat wells are usually more expensive than this due to the increased time spent in testing potential producing zones and in taking precautions against possible drilling hazards in the deep formations.

As more prolific oil and gas reservoirs are discovered below 12,000 ft, and further experience is gained in drilling and producing these high pressure wells, deeper wells will be drilled. The discovery and development of petroleum reserves in reservoirs near the 20,000-ft mark in the tidelands, coastal areas, and deep sedimentary basins of the world may not be as far in the future as some people suppose. Our modern drilling equipment and methods are capable of reaching this depth whenever it becomes necessary or particularly attractive.

K Marshall Fagin

For Hole Enlargement...

The "Bull Nose" Type Scraper — Product No. 500-D — with its longer round-end nose is used for scraping in directional or "off-vertical" holes.

...no other tool is equal to the BAKER ROTARY WALL SCRAPER

When it is desirable to enlarge the diameter of an open hole to an extent considerably greater than the diameter of the casing, you can depend upon this strong, safe Wall Scraper with blades which open positively when pump pressure is applied. The uncased hole can be *enlarged at any point,* and by changing to progressively larger sizes of blades, an amazingly increased diameter can be secured. For example, the No. 6 Scraper can be run safely through 9⅝" A.P.I. casing, and then will ream from a minimum of 9¼ inches to a maximum of 19 inches by changing to increasingly larger sized blades.

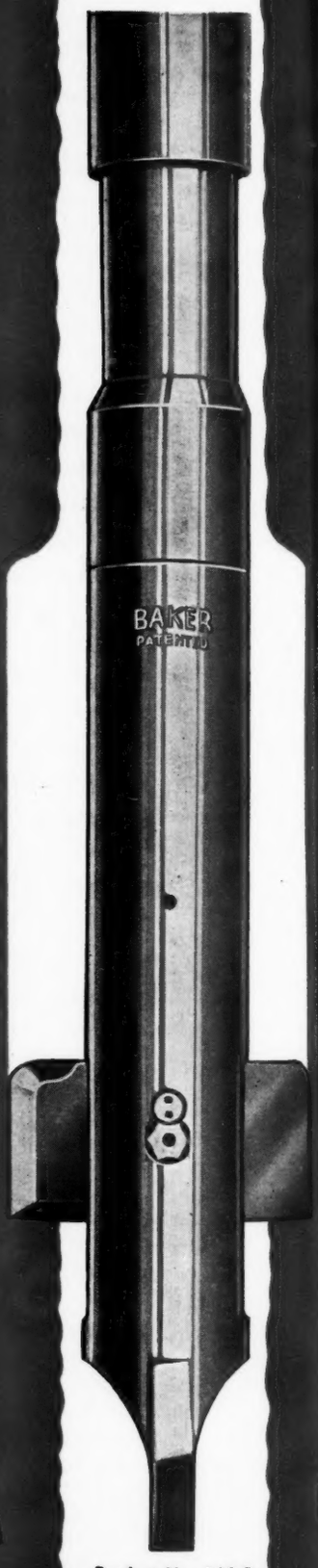
RUGGED BLADES CLOSE SAFELY

Baker Wall Scraper blades have extra-long vertical cutting edges which prevent any tendency to "corkscrew" and insure scraping the maximum footage of full-gauge hole. And, when the Scraper is to be removed from the hole, the pumps are shut down and a strong spring aids in closing the blades into the body. These blades are made from special alloy steel forgings, and their cutting surfaces are hardfaced and set with Tungsten Carbide inserts to insure long cutting life.

MANY IMPORTANT USES

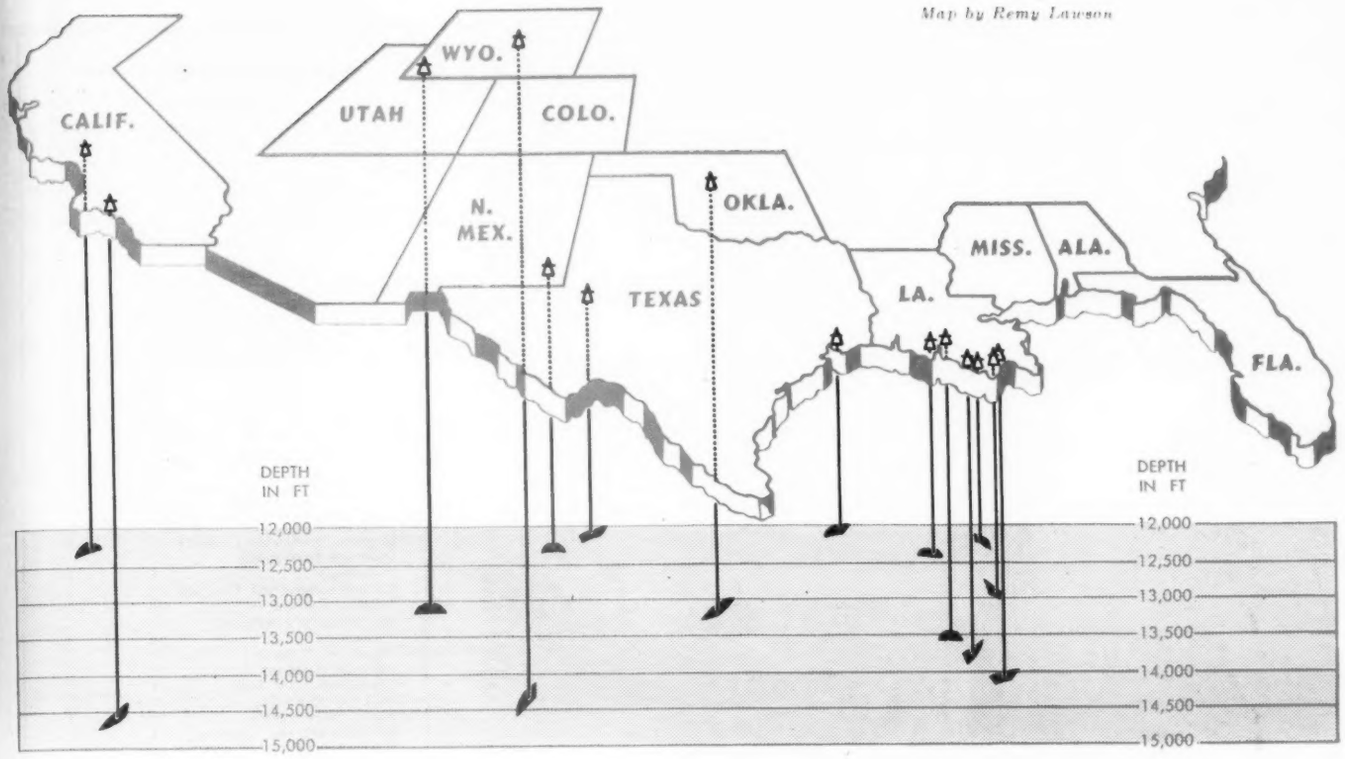
THE BAKER ROTARY WALL SCRAPER is extremely versatile, and is successfully and economically used for . . . Removing the mud sheath from the face of the producing formation prior to bringing-in the well — Gravel Packing — Bottlenecking — Enlarging at C.P. before running a combination string of casing — Removing sections of drillable pipe — Scraping a short distance below the shoe to expose fresh formation and test the water shut-off, as well as for many other applications in modern drilling.

A few of the worthwhile applications of the Baker Rotary Wall Scraper are shown on the opposite page and merit your careful study. Look also in your BAKER (or Composite) CATALOG for complete descriptions, illustrations and specifications.



Product No. 500-D

BAKER ROTARY HYDRAULIC EXPANSION WALL SCRAPER



New oil and gas fields below 12,000 ft discovered in the United States last year. Five are deeper than 14,000 ft.

Production Depth Record Shattered

In 1948 for the first time oil and gas were found deeper than 14,000 ft in commercial quantities, in not one but FIVE fields.

By ERNESTINE ADAMS*

DEFINITE proof that know-how in deep drilling is paying off is shown in the fifth annual survey of deep wells. Advanced methods and improved machinery have brought down costs of these wells (below 12,000 ft) despite increased costs of labor and materials. Not only are deep wells costing less but they are giving greater returns in oil and gas production. Thirteen new fields or new sands were discovered this year below 12,000 ft to add to the 21 already found.

For the first time in the history of the oil industry commercial production was found deeper than 14,000 ft and before the year was out five separate fields had production at these new record depths.

The drill pierced the 12,000 ft mark 179 times in 1948 of which 145 wells were completed and 34 are still drilling or testing. This makes 610 wells that are 12,000 ft or more in depth.

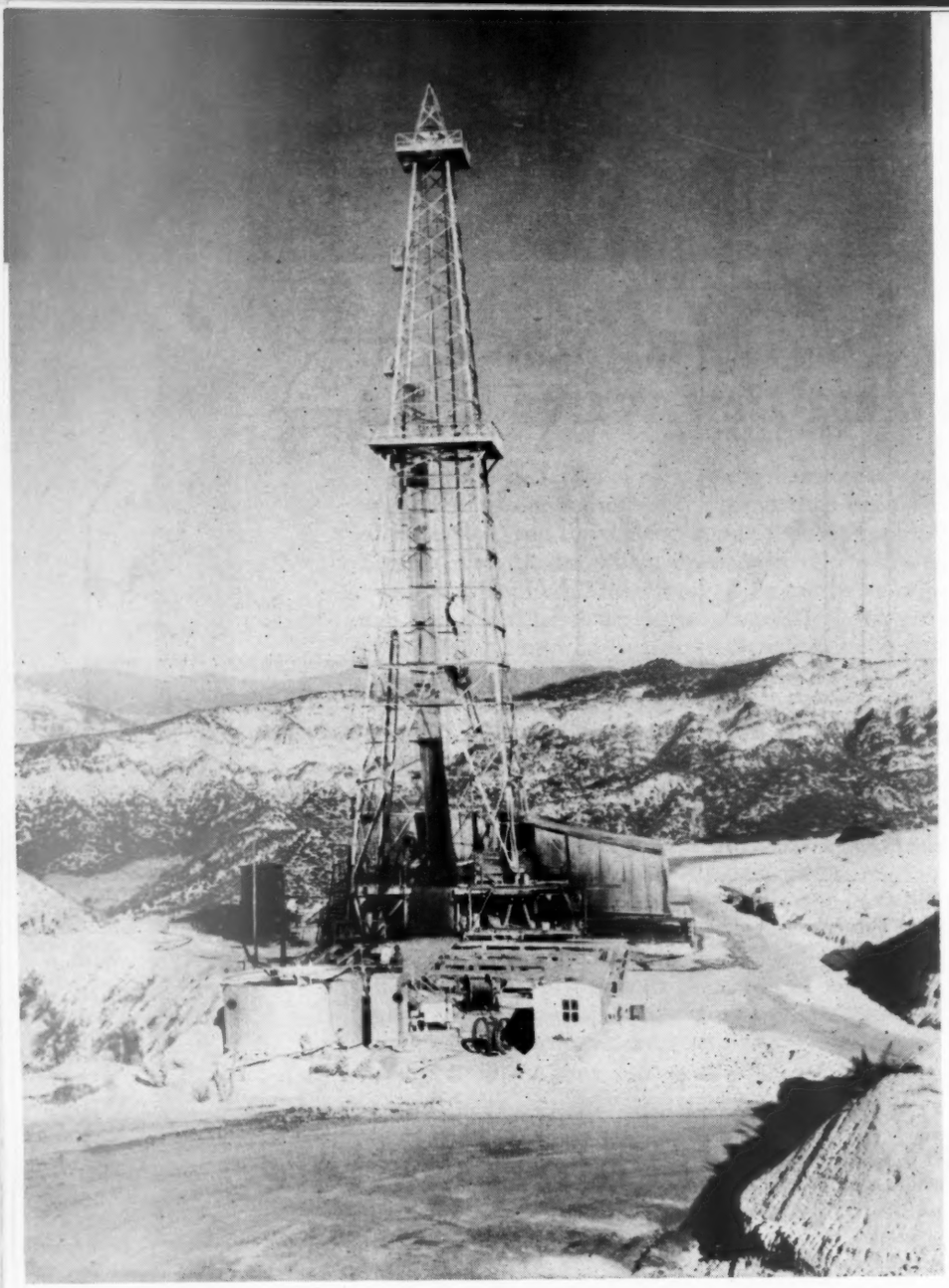
This report must inevitably be full of figures to supply evidence of trends but the whole result is contained in the satisfying statement that when oil was needed the industry went deeper, found more oil in deep formations than ever before, and managed to do it a little cheaper.

Acknowledgment

The descriptions of deep wells show the almost 100 per cent cooperation from companies that drill the deep ones. Our appreciation of this is increased by the fact that a majority of these also permitted us to use confidential cost figures for what is believed to be the most factual report on well costs available.

Dissemination of ideas on operations has been one safeguard of the development of the U. S. oil industry. Deep well information may help those pioneers who are hitting subterranean frontiers.

*Managing Editor.



Barnsdall's RSF 66-9 in Los Angeles County, California, is believed to have the deepest production known, 14,505 ft. Production of 50 bbl 28 gravity is not as much as that of Pure Poison Spider well, which held the previous record, but it has the deepest oil-producing sand, according to reports.

It is not recorded, but the 41 operators that drilled 1948 deep wells went about their duties more confidently because of the experience back of them and had the thrill of trying out new machinery and equipment designed especially for sinking the deep drill.

Economics

For the first time since 1942 average costs for drilling deep wells eased. Average cost of 145 completed deep operations in 1948 was $334,000 per well as compared with $363,000 in 1947. (Table 1.) Only one well cost below $100,000; on the other hand none reported over the million dollar mark this year.

This lessening of costs has been due largely to greater knowledge of deep drilling problems and how to meet them and to machinery and equipment better fitted to deep drilling.

Costs of deep drilling operations were reduced 8 per cent at the same time that costs of labor and equipment were rising and that average depth of wells increased.

TABLE 1. Number of deep wells and costs.

Year	Number deep wells in world	Estimated average cost per well in U. S.
1935	1	$415,000
1937	5	320,000
1938	13	288,000
1939	26	251,000
1940	16	242,000
1941	19	185,000
1942	16	150,000
1943	17	244,000
1944	38	253,000
1945	69	303,000
1946	96	340,000
1947	115	363,000
1948	145	334,000
Drilling or Testing	34	
Total	610	

TABLE 2. 1948 deep well operators.

Operator	Number of Producing Wells	Total Deep Wells
J. S. Abercrombie Company and Magnolia Petroleum Co.	0	1
Amerada Petroleum Corporation	0	1
*Australasian Petroleum Co., Ltd.	0	1
Barnsdall Oil Company	1	1
Burton-Sutton Oil Company, Inc.	0	1
The California Company	2	4
*Francis Callery Oil Company	0	1
*Canadian Gulf Oil Company	1	1
Amon Carter Oil Company	0	1
*Chicago Corporation	1	2
Cities Service Oil Company	1	1
Continental Oil Company	0	1
Denver Producing and Refining Co.		1
*General Crude Oil Company	0	1
Gulf Oil Corporation	6	16
Humble Oil & Refining Company	4	15
Hunt Oil Company		3
Magnolia Petroleum Company	4	5
Mountain Fuel Supply Company	1	1
*Mid-Continent Oil Company	1	1
*Norton, Richard W.	0	1
Pan American Production Company	0	1
Placid Oil Company	0	2
Pure Oil Company	1	1
*Richardson and Bass	1	1
Shell Oil Company	5	15
Skelly Oil Company	0	1
Slick-Urschel Oil Company	1	1
Standard Oil Company of Ohio	2	2
*Sparton Drilling Company	1	1
Standard Oil Company of California	1	3
Stanolind Oil & Gas Company	3	12
Sun Oil Company	1	3
Superior Oil Company of California	2	6
The Texas Company	10	24
*Tex Harvey Oil Company	1	1
Tide Water Associated Oil Company	10	11
Union Oil Company of California	0	4
Union Producing Company	0	3
Western Gulf Oil Company	0	1
*Wilshire Oil Company	1	1
TOTALS	62	145

*Companies that have not had deep wells prior to 1948.

Average depths in this type of well and costs per foot for the last five years run approximately like this:

	Average Depth	Average cost per foot
1944	12,671 ft	$19.97
1945	12,854 ft	23.57
1946	12,776 ft	26.61
1947	13,004 ft	27.91
1948	13,064 ft	25.57

It is quite a feat to cut $2.44 per foot from deep drilling costs under a steady pressure of rising prices.

Deep Production

No new depth record was made in 1948, Superior's Weller test in Oklahoma still retaining the title of deepest well with a total depth of 17,823 ft. The deepest production record, however, was passed not once but three successive times in 1948.

In June, Shell No. B-2 Smith-State found the first production below 14,000 ft in the Weeks Island field, Louisiana. It brought in 470 bbl oil 33 gravity and 475,000 cu ft of gas from 13,826-14,159 ft.

TABLE 2.
DESCRIPTIONS OF WELLS DRILLED BELOW 12,000 FT IN 1948

TD, ft PB, ft	Complt'd Spudded	Company and name of well	Drilled by	Field and location	Deepest form. Prod. form.	Casing and cementing schedule	Init. prod., grav., choke	Pressure*, GOR	Remarks
12,000 10,413	6– 1–48 12–23–48	Magnolia 1 Proctor	Company rig	Brooks, Tex.			41B 53.6° 1750 MCF	△4200 GOR 35,900	Wildcat. New field.
12,001	12–31–48 7–25–48	Gulf 1 Henry Melancon	Company rig	St. Martin, La.	Olig. Marginulina	75′ of 16″ SW 38.5* 250 sx.; 2492′ of 10¾″ SS 40.5* 1000 sx.; 3400′ of 5½″ SS 20*; 3900′ of 5½″ SS at 11,713′ 730 sx 17*; 4390′ of 5½″ SS	307B 5/32″ 229,636 CF 31.9°	‡1300 +10680 216 F GOR 748	Wildcat. Extension. Perf. 28 shots at 10,672-680′ Faulted dome. 83 bits.
12,001	12– –48 8–24–48	Pan American 1 Leonie M. White	J. C. Hawkins Houston, Tex.	Leonville, St. Landry, La.	Cane River	64′ of 16″ SW 100 sx.; 1805′ of 10¾″ 40.5* 650 sx.; Plug. 200 sx	Dry		Wildcat. DT 98 days.
12,002	3–27–48 12– 2–47	Stanolind 1 P. H. Maraist	Company rig No. 20	St. Martin, La.		2467′ of 10¾″40.5*; 7″ CSA 11,175″; 60′of 29*, 940′ of 23*, 5650′ of 23*, 2350′ of 26*, 2000′ of 29*	97B ¼″ 33.3°	©1650, ‡975, *5063, △1800, 220F, +11,070 GOR 680	Wildcat. New sand. Perf. 24 shots at 11,065-71′. Salt dome. 64 bits. DT 99 days.
12,008	9–17–48	Magnolia 1 Alvin Schubert		Driscoll Pasture, Nueces, Tex.			Dry		
12,009	9– 8–48 6–28–48	Stanolind 1 Powell Lumber	Loffland Bros., Houston, Tex.	Calcasieu, La.		10¾″ 40.5* CSA 2020′; 7″ CSA 9505′; 3400′ of 23*, 3750′ of 23*, 2350′ of 26*	Dry		Wildcat. 62 bits. DT 72 days.
12,010	5–20–48 6– 9–47	Sohio C-1 Sweet Lake Land & Oil Co.	H. L. Edwards Drilling Co., Houston, Tex.	Bell City, Calcasieu, La.	Hayes sand Cibicides hazzardi.	68′ of 16″ 38.5* 75 sx.; 2202′ of 10¾″ 40.5* 1000 sx.; 7″ 23*, 26*, 29* at 11,272′ 500 sx	19/64″ © 3000 178°		Wildcat. Discovered Bell City field. Anticline.
12,012		H. L. Hunt, et al 1-3 S. F. Wilson	Galveston, Tex.		Shale		Shut in		
12,012	7– 4–48 3– 4–48	Tide Water 67 Ventura Land & Water Co.		Ventura Ave., Ventura, Calif.			1201B 21/64″ 1458 MCF 31.3°	©550, ‡1150	
12,022	12– 6–47 8– –47	Slick-Urschel 1 D. L. Alford	Iron Drilling Co. Tulsa, Okla.	Benedum, Upton, Tex.	Ellenberger Ellenberger	12,018′ of 5″; 12,022′ of 2″	833B 3/8″ 3660 MCF 59°	©2400, ‡1850, §2950, △2950, *5200, +-9334 211F, GOR 4400	Wildcat. DT 6 years. Perf. 250 shots at 11,885-985′. Anticline.
12,026	3–20–48	Sun 4 Kenilworth Plantation		Kenilworth, St. Bernard, La.	Shale		Dry		
12,030	4–23–48 2–17–48	Texas 22 Falgout Holding	Hillburn Drlg. Co.	Golden Meadow, Lafourche, La.	Shale Sd.	10¾″ at 2479′ 500 sx; 7″ at 10,850′ 1060 sx	240B 5/64″ 38.4°	‡2650, GOR 2025	Per. 78 at 9779-92′
12,030	2–22–45 11– 6–44	[1]California 1 Pallet.	Noble Drlg. Corp. Tulsa, Okla.	Barataria, Jefferson, La.	Miocene	16″ 65* 300 sx; 10¾″ 40.5* 1500 sx;7″ 26*, 29*, 32*	362B 5/64″ 241 MCF 34.6°	‡1990 *5065 236F +11,450 Present reservoir pressure 4257 GOR665	Perf. 240 at 11,472–530: DT 90 days. 43 bits.
12,036	4– 5–48 12–27–47	Gulf 27 Delta Securities Co.	Gulf Production Division, Houston, Tex.	Bayou Couba, St. Charles, La.	Miocene	90′ of 20″ SS 48*; 1631′ of 13⅜″ SS 54.5*; 840′ of 13⅜″ SS 61*; 4323′ of 9⅝″ SS 47*; 357′ of 9⅝″ SS 43.5*; 506′ of 9⅝″ SS 47*; 1788′ of 9⅝″ SS 40*; 504′ of 9⅝″ SS 40*; 1667′ of 9⅝″ SS 47*	Dry		Wildcat. DT 100 days. 55 bits.
12,038	4– 9–48 10–19–47	Gulf A-31 M. P. Erwin	Gulf Production Division, Houston, Tex.	E. Hackberry, Cameron, La.	Dome material. Broken sand and shale	73′ of 20″ SW 48*; 1242′ of 13⅜″ 61*; 1229′ of 13⅜″ 54.5*; 2854′ of 9⅝″ 47*; 375′ of 9⅝″ 47*; 1267′ of 9⅝″ 43.5*; 4687′ of 9⅝″ 40*	147B 426,000 MCF 33°	‡1300 GOR 2897	Perf. 132 at 8756-78′. 40 bits.
12,047	10–14–48 8–22–48	Sun 1 Palfrey		St. Mary, La.	Miocene	16″ 38.5* at 112′; 100 sx.; 10¾″ 40.5* at 3140; 500 sx	Dry		Wildcat.
12,053		Tex-Harvey 1 B. W. Floyd- R. R. Comm.		Midland, Tex.			139B		
12,060	10–26–48 7–31–48	Shell 1-C Smith Unit	Company tools	Weeks Island, Iberia, La.			358B 195 MCF 34°	‡1625 GOR 544	Perf. 16 at 11,738-746′.
12,070	12–12–48 8–25–48	Tide Water 28 Hartman		Ventura Ave., Ventura, Calif.			1005B 21/64″ 733 MCF 31.5°	©200, ‡1000	Deepened from 7607′ on 8-25-48.
12,072	5–18–48 12– 8–47	Gulf 1-A L. L. & E., Little Lake	Rowan Drlg. Co., Houston, Tex.	Little Lake, Jefferson, La.	Miocene Miocene sd.	110′ of 20″ SW 48*; 1211′ of 13⅜″ SS 61*; 653′ of 13⅜″ SS 54.5*; 9⅝″ 3920′ of SS 47*, 1274′ of SS 43.5*, 3986′ of SS 40*; 5½″ 3747′ of SS 20*, 3227′ of SS 17*, 1566′ of 17*, 1428′ of 15.5*	142B 5,570 MCF 53.4°	‡3350, △3700, *9875, 186 F, GOR 39,200	Wildcat. Discovered Little Lake field. Perf. 30 at 9889-94′. 42 bits. Fault trap structure. DT 90 days.
12,100	2–27–48 9–21–47	Humble 1 South Mayes Unit	J. C. Means, Jr. Beaumont, Tex.	South Mayes, Chambers, Tex.	Frio Frio	2980′ of 13⅜″ SS 61*; 10,036′ of 9⅝″ SS 40* & 43.5*; 12,012′ of 5½″ SS 20* & 23*	134B cond. 1334 MCF ⅛″ 47.8°	‡3870, △6220, +12,003, 255 F, *8070 GOR 10,000	Wildcat. Discovered new sd. Perf. 27 at 12,021-26′. 61 bits. Salt dome. DT 161 days Deepest producing well in Texas.
12,102	4–12–48 1–26–48	Texas 6 State	Company tools	Horseshoe Bayou, St. Mary, La.	Sh. & lime Sd.	10¾″ set at 2516′, 500 sx; 7″ set at 12,102′, 750 sx	443B 19/64″ 35°	‡1950	Perf. 84 at 11,990-12,004′.
12,107	6–14–48 7–28–48	Humble 1 St. Martin Land	Hawkins-Graham	Atchafalaya, St. Martin, La.		141′ of 20″ 48*; 2607′ of 13⅜″ 61*; 6817′ of 9⅝″ 40*	Dry		Wildcat. DT 120 days. 64 bits
12,113	12– 2–48 8–18–48	Humble 2 C. G. Hooks	Company rig	Avery Island, Iberia, La.		118′ of 20″ 48*; 1844′ of 13⅜″ 61*; 9965′ of 9⅝″ 40*	Dry		Wildcat. DT 107.5 days. 66 bits.
12,120	10–24–48 6–24–48	Humble 1-C Gulf Coast Realty Co.	Ballew	SW Lake Trafford, Collier, Fla.		63′ of 20″ 77*; 1102′ of 13⅜″ 61*; 4998′ of 9⅝″ 40*; 11,887′ of 5½″ 17*	Dry		Wildcat. DT 126 days. 46 bits
12,141	–47	[1]Superior 1 Draughn		12-3n-14w Forrest, Miss.	L. Cret.		Dry		Wildcat.
12,150	7–30–48 5– 3–48	California 50 Delta Farms	Loffland Bros. Tulsa, Okla.	Delta Farms, Lafourche, La.	Sdy. sh. Miocene	16″ 65* 300 sx; 10¾″ 40.5* 1250 sx; 7″ 23*, 26*, 29* & 32* 600 sx	256B 1/8″ 202MCF 34.5°	‡1450 *4045 179F †8880 GOR 789	Perf. 12 at 8920-22′. DT 45 days. 37 bits. Salt dome.

*Pressure is indicated by ©flowing casing, ‡flowing tubing, §shut in casing, △shut in tubing, ©initial reservoir, +datum. [1]Deep well not included in previous surveys.

DESCRIPTIONS OF WELLS DRILLED BELOW 12,000 FT IN 1948

TD, ft PB, ft	Complt'd Spudded	Company and name of well	Drilled by	Field and location	Deepest form. Prod. form.	Casing : ..ating schedule	Init. prod., grav.. choke	Pressure*, GOR	Remarks
12,150	4-13-48 Deepened	Tide Water 17 Hartman	Company rig	Ventura Avenue, Ventura, Calif.	D-7 zone	6⅝" set at 10,000'; 1572' of 4½" set at 12,045"	1173B 34/64" 1058 MCF 32.6°	⊖200, ‡1150	Production from 12,050'.
12,153	10-27-48 9-30-48	Union of Calif. 1 R. W. Collins	Dixie Drlg. Co., Houston, Tex.	Houma, Terrebonne, La.		10¾" 40.5* CSA 2427', 1000 sx; 16" 62* CSA 97'	Dry		DT 23 days. 19 bits.
12,159	2-20-48 11- 8-47	Sparton 4 B & D Unit	Sparton Drlg. Co., Dallas, Tex.	Golden Meadows, Lafourche, La.	L. Miocene L. Miocene	16" 55* at 197', 150 sx; 10¾" 40.5* at 3025', 1000 sx; 7" 32*, 29*, 26* at 12,100' 1200 sx	363B 16/64" 429 MCF 36.8°	‡4000, 180 F, GOR 1173	Production from 11,803-07'. Faulted dome.
12,188	10-31-48 9- 3-48	California 13 E. P. Brady	Loffland Bros. Tulsa, Okla.	S. Barataria, Jefferson, La.	Shale	16" 65* 250 sx; 10¾" 40.5* & 45.5* 1000sx	Dry		DT 52 days. 35 bits.
12,196	5-28-48 2- 3-47	Texas 1-B Harrell	Lynn Drlg. Co., Tulsa, Okla.	Stephens, Okla.	Simpson Bromide L. Tussy sd.	13⅜" 48* at 722'; 7" at 10,325'; 3296' of 29*, 2198' of 26*, 4271' of 23*, 470' of 32*	6B cond. 962 MCF GOR 160,333	⊖900, ‡850, §1400, ^1100,	Wildcat. Discovered new sand. Anticline. Perf. 240 at 5035-120'. DT 480 days.
12,202	11-15-48 5-30-48	Stanolind 1 E. S. Boyles	Company rig No. 18	Chocolate Bayou, Houston, Tex.	L. Frio L. Frio	2429' of 10¾" 40.5*; 11,630' of 7" 23*; 3900' of 23*, 2300' of 26*; 2700' of 29*	32B 444 MCF	⊖450, ‡900 GOR 12,252	89 bits. DT 128 days. Perf. 46 at 11,537-49'.
12,226	4-17-48 8-10-47	Union Producing 3 Addie Durrett	Wheless Drilling Co.	Sugar Creek, Claiborne, La.	Smackover	175' of 16" 55*, 150 sx; 3293' of 10¾", 1195' of 45.5*; 2097' 40.5*, 325 sx	Dry		Wildcat. 64 bits. DT 232 days
12,240 11,523	11-20-48 2-22-48	Tide Water Ventura Land & Water Co.		Ventura Ave., Ventura, Calif.			286B 20/64" 267 MCF 26.4°	⊖700, ‡175	Deepened from 8555' on 2-22-48.
12,258	4-22-48 9- 1-47	Mid-Continent 1-A U. D. Sawyer	McVay & Stafford Tulsa, Okla.	Crossroads, Lea, N. Mex.	Ellenburger	214' of 13⅜" 40*, 300 sx; 3706' of 9⅝" 36*, 2800 sx; 12,255' of 5½" SS 20*, 700 sx	3980B 34/64" 170 MCF 42.5°	⊖615, ‡415, §733, ^698, *4863, 198 F, +12,175, GOR 43	Wildcat. Discovered Crossroads field. Perf. 600 at 12,115-215'. 195 bits.
12,273	6-16-48 12-20-47	Texas 7 Woodward, Kepper & Longmire	Bateman Drlg. Co. New Orleans, La.	Bateman Lake, St. Mary, La.	Sdy. sh.	10¾" at 2561' 500 sx; 7" at 10,801 750 sx; 5" at 11,326' 300 sx	Salt water		Wildcat. Temorarily abandoned. Extension.
12,285	2-12-48 8-16-47	Texas 1 State Willow Bayou	Cron & Gracey Drlg. Co. Houston, Tex.	Willow Bayou, Cameron, La.	Shale	10¾" at 2659' 600 sx; 7" at 9860' 1000 sx.	Dry		Wildcat.
12,294	11- -48 4-16-48	Stanolind 2 E. M. Watkins	John W. Mecom Houston, Tex.	Florence, Vermilion, La.		2788' of 13⅜" 54.5*; 10,055' of 9⅝" 40* and 53.5*	Dry		Wildcat. DT 149 days.
12,308		Skelly 1 Sawyer		Lea, N. Mex.					
12,342	10-31-48 9- 1-48	Texas 5 State Barataria	Company tools	Queen Bess Island, Jefferson, La.	Sh. & lime	13⅜" at 2010' 500 sx	Dry		Wildcat.
12,344	3-28-48 11-10-47	Tide Water 40 Buras Levee Dist.		Venice, Plaquemines, La.	Sd & Sh. Sand	20" at 224' 250 sx; 13⅜" at 2500' 700 sx; 9⅝" at 9465' 1000 sx; 5½" at 11,502' 1000 sx	260B 36.1°	‡1600 GOR 930	Perf. at 9872-74', 9916-18' and 9897-9917'.
12,345	3- 5-48 1-25-48	Union of Calif. 1 Delta Securities	Dixie Drlg. Co., Houston, Tex.	Lafourche, La.		10¾" 40.5* set at 2543', 1000 sx	Dry		Wildcat. DT 40 days. 36 bits.
12,355	3-21-48 12-28-47	Union of Calif. 3 City of N. Orl'ns	Loffland Bros., Houston, Tex.	Lafourche, La.		16" set at 169', 200 sx; 10¾" 40.5* set at 2479', 925 sx	Dry		Wildcat. DT 77 days. 51 bits.
12,366	7-24-48 3- 1-48	Stanolind B-1 Wilberts Mineral	Dixie Drlg. Co., Houston, Tex.	Bayou Blue, Iverville, La.		1225' of 13⅜" 48*; 9⅝" CSA 9223' 43* and 53.5*	Dry		Wildcat. DT 141 days. 67 bits
12,367	8-23-48 2-29-48	Humble 1 Rose H. Barnett	Rowan Drilling	Upland, Upton, Tex.		16" at 315'; 10¾" at 3757'; 7⅝" at 8280'	Dry		Wildcat. DT 180 days. 217 bits.
12,386	12-30-48 7-25-47	Gulf 18 Lafourche Levee Dist.	Company rig	Lake Hermitage, Plaquemines, La.	Miocene	103' of 20" SW 48*, 100 sx; 1201' of 13⅜" SS 61*; 1311' of 13⅜" SS 54.5*, 1000 sx; 3144' of 9⅝" SS 47*; 1229' of 9⅝" SS 43.5*; 4815' of 9⅝" SS 40*, 1000 sx; 4233' of 5½" SS 20*; 7496' of 5½" SS 17* 500 sx	Dry		Wildcat. Dt 526 days. 139 bits.
12,389	1-12-48 9-14-45	[1]Stand'd of Calif. 73-30V Bolsa Chica	Rocky Mt. Drlg. Co.	Kettleman Hills, Middle Dome, Kings, Calif.	Eocene Eocene	9⅝" at 7585'; 6⅝" & 7" at 12,072; 4¾" at 12,276'	530B 47.2° 5230 MCF	⊖2200 ‡1900	Wildcat. Extension. Discovered new sand. Perf. at 12,075-276'.
12,423	6- 5-48 1- 9-48	Humble B-4 E. B. Schwing	Company rig	Bayou des Glaise, Iberville, La.		120' of 20" 48*; 2554' of 13⅜" 61*; 9523' of 9⅝" 40*	Dry		DT 161 days. 91 bits.
12,442	8- 6-48 5-18-48	Chicago Corp. 1 Liquidators	Loffland Bros., Tulsa, Okla.	Lafayette, La.	Frio	70' of 16"; 1996' of 10¾"; 10,775' of 7"	Dry		Wildcat. DT 80 days.
12,490	3-31-48 12- 5-47	J. S. Abercrombie Co. & Magnolia 1 C. H. Maxwell	Company rig Houston, Tex.	Brazoria, Tex.	Frio	13⅜" 54.5* at 1407', 450 sx; 9⅝" 40* at 6972', 1000 sx	Dry		Wildcat. DT 118 days. 90 bits.
12,493 12,210	11- 2-48 2-21-48	Magnolia 1 V. M. Powers		Chitwood, Grady, Okla.		13⅜" at 731', 700 sx; 9⅝" at 5445', 1000 sx; 7" at 12,120', 700 sx; 488' of 5" to 12,493', 75 sx	337B 18/64" 39.8°	‡2100 GOR 1250	
12,500	11- -48 5-26-48	Sun 1 Swift		South Melville, St. Landry, La.	Wilcox		190B 13/64"	^3300	Wildcat.
12,502	6-27-48 3- 8-48	Texas 5 Miami Fee Corp.	Loffland Bros. Tulsa, Okla.	Cameron Meadows, Cameron, La.	Sh. & lime	13⅜" at 1847' 600 sx	Dry		Wildcat.
12,505	8-14-48 4- 5-48	Stanolind 1 Miami Corp.	Noble Drlg. Corp. Houston, Tex.	Cameron, La.	Shale	2300' of 10¾" 40.5*; 12,500' of 7", 4300' of 23*, 1700' of 23*, 2300' of 26*, 2600' of 29*, 1600' of 32*	Dry		Wildcat. DT 78 days. 72 bits.
12,505	9-14-48 3- 2-48	Slick Urschel 1 Standifer	Hewgley Drlg. Co. Midland, Tex.	Benedum, Upton, Tex.	Granite Ellenberger	7" at 11,109' 800 sx; 5½" at 11,572' 100 sx; 4" at 12,505' 100 sx	1133B ⅝" 3955 MCF 60.3°	‡2500, ^2950, *4942, 204F, +-8540, GOR 3485	DT 180 days. Perf. 1010 at 11,280-490'. Anticline

*Pressure is indicated by ⊖flowing casing, ‡flowing tubing, §shut in casing, ^shut in tubing, *initial reservoir, +datum.

[1]Deep well not included in previous surveys.

DESCRIPTIONS OF WELLS DRILLED BELOW 12,000 FT IN 1948

TD, ft PB, ft	Complt'd Spudded	Company and name of well	Drilled by	Field and location	Deepest form. Prod. form.	Casing and cementing schedule	Init. prod., grav., choke	Pressure*, GOR	Remarks
12,505	8-21-46	Magnolia 2 Bolton		Glendale, Trinity, Tex.	Lime	20″ at 89′-110′; 7″ at 10,642′; 1000 sx	Shut in ¾″ 38,000 MCF		Wildcat. Discovered Glendale field.
12,507		[1]Skelly 1 J. G. Long		E. Bay City, Matagorda, Tex.					
12,516	9-21-48 4-22-47	Canadian Gulf 1 Pincher Creek	Parker Drlg. Co. of Canada, Tulsa, Okla.	Pincher Creek, Alberta, Canada	Madison Madison	7″ 23*, 26*, 29*, 32* at 11,755′, 5000 sx; 5″ 18* set at 12,500′, 500 sx	385B cond. Shut in 9800 MCF 52.5°	⊖2600, ‡2000, ^3300, •4800, •7753, 184 F, GOR 25,440	Wildcat. Discovered Pincher Creek field. DT 425 days. 236 bits.
12,525	11-12-47 10- 2-47	Union of Calif. 1 J. A. Theriot	Dixie Drlg. Co., Houston, Tex.	Houma, Terrebonne, La.		16″ 38* at 139′, 100 sx; 10¾″ 40.5* at 2457′, 1000 sx; 5½″ 17* at 10,408′, 750 sx	Cond. Shut in	Present reservoir pressure, 4582	26 bits. DT 36 days.
12,541	4-16-48	Richardson & Bass 1H.F.&A.D.Neal	Big West Drlg. Co. Ft. Worth, Tex.	Neal Ranch, Upton, Tex.	Ellenburger Penn.	9⅝″ at 8100′; 7″ 29* at 11,977′	342B	‡375, ^1125, GOR 1552	Wildcat. Discovered Neal Ranch field. Perf. at 10,020-50′. DT 207 days.
12,548		Superior 1 McDaniel		Garvin, Okla.			Dry		
12,558	2- 3-48 8- 7-47	Amon Carter 1 Fee	Big West Drlg. Co. Dallas, Tex.	Winkler, Tex.	Ellenburger	256′ of 20″; 2850′ of 13⅜″; 5330′ of 9⅝″	Dry		Wildcat.
12,564	7-22-48 1- 6-48	Shell 3 Myles Salt	Company tools	Weeks Island, Iberia, La.		16″ at 118′; 10¾″ at 4517′; 7⅝″ at 11,830′; 5″ at 12,563′	400B 425 MCF 34°	‡2550 GOR 1060	Salt dome. Perf. 35 at 12,487 98′.
12,585 5,200		[1]Stewart et al 14 Fee		Hitchcock, Galveston, Tex.	Frio				
12,591 8,050	4-23-48 5-25-47	Cities Service 1-B Rogers	Loffland Bros., Tulsa, Okla.	Garvin, Okla.	2nd Bromide Deese	13⅜″ SS 48* at 512, 500 sx; 9⅝″ SS 36* and 40* at 5904′, 500 sx; 7″ SS 23* and 26* at 7975′, 1350 sx	231B ½″ 1150 MCF 43.4°	‡200, ^1500, ⊖2450, •6900, GOR 1150	Wildcat. Discovered new field. DT 334 days. 202 bits.
12,611	7-20-48 5-16-48	California 1 State lease 816, block 24	Noble Drlg. Corp. Tulsa, Okla.	Plaquemines, La.	Shale	16″ 65* 550 sx; 10¾″ 40.5* 1490 sx	Dry		Wildcat. DT 62 days. 40 bits.
12,620	8- 3-48 3-21-48	Tide Water 23 McGonigle		Ventura Ave., Ventura, Calif.			1077B 20/64″ 814 MCF 31.3°	⊖700, ‡1200	
12,621	3- -48	Australasian Pet. 1 Kariava		Papua, New Guinea			Dry		Wildcat.
12,644	3-15-48 1-10-48	Humble 12 Louisiana Furs	Company rig	Pecan Island, Vermilion, La.		16″ 48* at 108′; 10¾″ at 2499′	Dry		DT 65 days. 34 bits.
12,656	8- 2-48 11-27-47	Texas 11 State Rabbit Island	Loffland Bros. & Company rig	Rabbit Island, Iberia, La.	Sh. & lime Sand	13⅜″ at 2589′ 650 sx; 9⅝″ at 11,462′ 1200 sx; 7″ at 12,594′ 300 sx	½″ 10,300 MCF	‡7000, ^8150	Wildcat. Discovered new sand Perf. 38″ at 12,436-46′.
12,675	7- 2-48	Hunt 1 Ardis Burns		Webster, La.	Shale		Dry		Wildcat.
12,677	6- 5-48 3-15-48	Humble B-1 Louisiana Furs	Company rig	Pecan Island, Vermilion, La.	Sand	20″ 48* at 90′; 13⅜″ 61* at 2519′; 7″ at 12,267′	115B Shut in 4800 MCF ¼″ 50.3°	‡3800 GOR 41,740	Wildcat. DT 85 days. 38 bits.
12,710	5-14-48 12-21-47	Tide Water 74 Ventura Land & Water Co.		Ventura Ave., Ventura, Calif.			984B 20/64″ 710 MCF 34.3°	⊖900, ‡1150	
12,760	7- 4-48 10-13-47	Stanolind 1 G. W. Henry	C. G. Glasscock Corpus Christi, Tex.	Tilden, McMullen, Texas		1480′ of 13⅜″ 54.5*; 9⅝″ CSA 7520′; 86′ of 53.5*; 2850′ of 40*; 4490′ of 40*; 74′ of 40*	Dry		Wildcat. DT 243 days. 104 bits.
12,776	10- -48 12- 1-46	Stanolind 1 Huebner	Company rig	Lucky, Matagorda, Tex.	Sloan sand Frio sand	10¾″ 40.5* CSA 1538′; 6970′ of 9⅝″ 23* and 26*	79B 124 MCF 34°	‡890, ^949 GOR 1570	Wildcat. Extension. DT 125 days. 40 bits. Anticline.
12,780	3-24-48 11- 7-47	Texas 1 Luke Guidroz	Nicklos Drlg. Co.	Valentine, Lafourche, La.	Shale Sand	13⅜″ at 3141′ 500 sx; 7″ at 11,621′ 1000 sx	25B ⅝″ 4860 MCF 51.4°	GOR 194,500	Wildcat. Perf. 192 at 11,036-91′. Discovered new sand. Extension.
12,786	9-21-48 4-25-48	Humble 6 Henry L. Cords	Allen & Morris	Flour Bluff, Nueces, Tex.	Sand		Shut in		Wildcat. DT 157 days. 91 bits. Discovered new sand.
12,792	1948 10- 5-47	[2]Western Gulf 74-1 Paloma Unit	Loffland Bros. Los Angeles, Calif.	Paloma, Kern, Calif.	Miocene	13⅜″ at 1254′, 7″ at 11,892′	Dry		Anticline
12,795	12-31-48 7-10-48	Tide Water 77 Ventura Land & Water Co.		Ventura Ave., Ventura, Calif.			1044B 22/64″ 840 MCF 31.9°		
12,850	10- 3-48 6-19-48	Shell 3 Dugas & Le Blanc	Cron & Gracey	Napoleonville, Assumption, La.		16″ at 108′, 200 sx; 10¾″ at 3017′, 600 sx	Dry		
12,887	8-11-48	Hunt 1 E. W. Finney		Terrebonne, La.	Salt water		Junked		Wildcat.
12,888	5- 1-48 12-27-47	California 14 Delta Farms	Noble Drlg. Corp. Tulsa, Okla.	Delta Farms, Lafourche, La.	Miocene	16″ 65* 300 sx; 10¾″ 40.5* & 45.5* 1250 sx; 7″ 23*, 26*, 29*, & 32* 1000 sx	240B 279 MCF ⅛″ 23.1°	‡900 GOR 1162	DT 104 days. 70 bits. Perf. 48 at 11,811-19′. Salt dome.
12,905	11-21-48 6- 9-48	Tide Water 25 McGonigle		Ventura Ave., Ventura, Calif.			1362B 18/64″ 1031 MCF 32.7°	⊖1700 ‡1600	
12,950	4- 1-48 6- 2-47	Gulf 1 Cleobule Hernandez	Loffland Bros. Houston, Tex.	Lafayette, La.	Mio. wet	104′ of 20″ SW 48* 250 sx; 1221′ of 13⅜″ SS 61*; 1294′ of 13⅜″ SS 54.5*, 1200 sx; 3706′ of 9⅝″ SS 47*; 760′ of 9⅝″ SS 40*, 1000 sx; 3072′ of 5″ SS 18*; 4499′ of 5½″ SS 20*; 4607 of 5½″ SS 18*, 225 sx	Dry		Wildcat. DT 164 days. Faulted dome.
12,963	10-21-48 7-22-48	Shell B-3 Smith State		Weeks Island, Iberia, La.			389B 455 MCF 34°	‡2550 GOR 1169	Perf. 40 at 12,858-68′. Salt dome.

*Pressure is indicated by ⊖flowing casing, ‡flowing tubing, §shut in casing, ^shut in tubing, •initial reservoir, *datum.

[1]Deep well not included in previous surveys. [2]Well listed but not described in 1947 survey.

DESCRIPTIONS OF WELLS DRILLED BELOW 12,000 FT IN 1948

TD, ft PB, ft	Complt'd Spudded	Company and name of well	Drilled by	Field and location	Deepest form. Prod. form.	Casing and cementing schedule	Init. prod., grav., choke	Pressure*, GOR	Remarks
12,975	3- 3-48 10-19-47	Gulf 1 M. D. Riley	Roeser & Pendleton, Shreveport, La.	Heidelberg, Jasper, Miss.	L. Cret.	20″ 78.6* set at 51′, 75 sx; 13⅜″ SS 54.5*, 61* and 72*, set at 1568′, 1000 sx	Dry		Wildcat. DT 143 days. 74 bits.
12,981	2- 4-48 9- 4-47	Humble 14 Petit Anse	Company rig	Avery Island, Iberia, La.		120′ of 20″ 48*; 2468′ of 13⅜″ 61*; 10,491′ of 9⅝″	Dry		DT 141 days. 73 bits.
12,984	12- 9-48 4-30-48	Gulf 1 S. S. Perry	Nickols Drlg. Co., Houston, Tex.	Peach Point, Brazoria, Tex.	Marginulina-Texana Marginulina-Texana	119′ of 20″ SW 48*, 180 sx; 971′ of 13⅜″ SS 61*; 2438′ of 13⅜″ 54.5*, 2400 sx; 2461′ of 9⅝″ SS 47*; 4665′ of 9⅝″ SS 43.5*, 800 sx; 10,812′ of 7″ 26*, 550 sx; 11,431′ of 5½″ SS 18*, 150 sx; 11,199′ of 2⅞″ SS 6.4*	Closed in	‡7000, ^8375, 229 F	Wildcat. Discovered Peach Point field. Faulted dome. DT 200 days. 71 bits. Perf. 280 at 11,278-348′.
13,000	4- 7-48 11-19-47	Gen'l Crude B-21 Sun-Stanolind Esperson Fee	Company rig Houston, Tex.	S. Esperson, Liberty, Tex.	Salt	1371′ of 13⅜″ 48*; 1803′ of 9⅝″ 40*; 7075′ of 9⅝″ 40*, 800 sx	Dry		DT 138 days.
13,000	1-30-48 10-28-47	Gulf 1 W. P. Foster	Rowan Drilling, Houston, Tex.	Franklin, St. Mary, La.	Miocene	119′ of 20″ SW 48*; 1372′ of 13⅜″ SS 61*, 1128′ of 13⅜″ SS 54.5*; 3077′ of 9⅝″ 47*, 1012′ of 9⅝″ 43.5*; 5034′ of 9⅝″ 40*	Dry		Wildcat. DT 94 days. 64 bits.
13,006	8- -48	W. T. Burton 1 S. J. Simmoneax	Company rig	Des Allemands, St. Charles, La.	Planulina harangensis	4000′ of 10¾″ 40.5*, 2000 sx	Dry		Wildcat.
13,014	6-25-48 4- 2-48	Gulf 60 La. State "QQ"	Gulf Production Division, Houston, Tex.	Quarantine Bay, Plaquemines, La.	Miocene Miocene	75′ of 20″ SW 48*; 840′ of 13⅜″ SS 54.5*; 1271′ of SS 13⅜″ 61*; 361′ of 13⅜″ SS 13⅜″ 61*; 361′ of 13⅜″ SS 68*; 4938′ of 9⅝″ SS 47*; 2390′ of 9⅝″ SS 47*; 1849′ of 9⅝″ SS 40*	229B 11¼″ 28.2°	‡875 GOR 366	Wildcat. Extension. DT 85 days, 32 bits. Perf. 72 at 8330-40′. Salt dome.
13,016	9-23-48 2-23-48	Mt. Fuel Supply 4 Unit	San Joaquin Drilling Co., Los Angeles, Calif.	Church Buttes, Sweetwater, Wyo.	Morrison Dakota	13⅜″ SS 61* at 313′, 220 sx; 9⅝″ 40* and 43.5* at 7015, 3000 sx; 6⅝″ 24*, 28* and 32* at 12,768′, 2000 sx	29,600 MCF ½″	^5625 °7100 est, 230 F	Wildcat. Extension. 224 bits. Anticline.
13,046 10,672	2-17-48 3- 7-47	Magnolia et al 1 Lillian Miller	Company rig	Caddo, Okla.	Penn. Penn.	20″ at 148′, 150 sx; 13¾″ at 1785′, 1500 sx; 9⅝″ at 10,470′, 1000 sx; 7″ at 13,046′, 500 sx	195B ¼″ 44°	GOR 2790	Wildcat. Discovered new field.
13,067	7- 1-48 1- 6-48	Texas 110 LL&E Leeville	Hillburn Drlg. Co.	Leeville, Lafourche, La.	Shale	13⅜″ at 3069′ 500 sx; 8⅝″ at 11,762′ 1000 sx	Dry		Wildcat.
13,067	11-16-48 5-22-48	Sohio 1 S. W. Sweeney	Meredith Clegg & Hunt	Hog Bayou, Cameron, La.	Miocene	16″ SW 38.5* set at 60′, 75 sx; 10¾″ 40.5* set at 2577′, 1000 sx; 7″ SS 23*, 26* and 29* at 11,282′, 1200 sx	No test	^3000, +11,007 192 F	Wildcat. Discovered Hog Bayou field. Anticline. DT 170 days. Perf. 200 at 8250-75′.
13,100	12-23-47 10-26-46	Gulf & Magnolia 1 Ida	Parker Drlg. Co., Tulsa, Okla.	Chitwood, Grady, Okla.	Penn. sand Penn. sand	5½″ 18* at 13,100′, 180 sx; 7″ at 11,660′, 1000 sx; 23*, 26*, 29*, and 32*	80B 450 MCF 40.9°	°500, ‡50, §2000, ^2200, °6500, +10,870 185 F GOR 5600	Wildcat. Extension. Perf. at 11,980′-12,000′. 191 bits. DT 341 days.
13,103	11-22-48 2- 9-48	Gulf 18-3B-VA	H. L. Kellog & Sons, Compton, Calif.	Buena Vista, Kern, Calif.	Miocene	7″, 26*, 29*, and 32* cemented at 10,764′	Dry		Wildcat. DT 266 days. 276 bits.
13,110	1-22-48 11-26-47	F. A. Callery 1 E. P. Brady	Bankhead Drl. Co. Baton Rouge, La.	Lapeyrouse, Terrebonne, La.	Miocene	162′ of 16″ SW 43.5*, 150 sx; 3482′ of 10¾″ SS 40.5*, 200 sx	Dry		Wildcat. DT 58 days. 38 bits. Faulted fold.
13,132	9-20-48 4-29-48	Gulf 1-A E.H.Lindsey et al	Steen Drlg. Co., Houston, Tex.	Fannett, Jefferson, Tex.	Frio	103′ of 20″ SW 48*, 155 sx; 1807′ of 13⅜ 54.5*, 1400 sx; 2479′ of 9⅝″ SS 47*; 4973′ of 9⅝″ SS 43.5*; 998′ of 9⅝″ SS 40*, 1000 sx	Dry		DT 154 days. 50 bits.
13,175	5-15-48 8-19-47	Continental L-2 KCL	Coastal Drlg. Co. Los. Angeles, Calif.	Kern, Calif.	Stevens sd.	13⅜″ 61*; 7″ 23* to 32*	Dry		Wildcat. DT 224 days. 152 bits.
13,213	5- 9-48 5- 1-47	Tide Water 36 Buras Levee Dist.		Venice, Plaquemines, La.	Sand	24″ at 103′ 200 sx; 20″ at 223′ 300 sx; 13⅜″ at 2490′ 700 sx; 9⅝″ at 9498′ 1000 sx; 7″ at 12,552′ 1000 sx	422B 36.2°	‡3950 GOR 1490	DT 373 days. Perf. at 12,765 842′.
13,230	11-11-48 5-16-48	Superior 1 LLE State Unit 19	Company rig	Four Isle, Terrebonne, La.	Miocene Miocene	18″ at 131′ 225 sx; 11¾″ 47* at 2101′ 1200 sx; 7⅝″ 33* & 39* at 12,015′ 1300 sx	294B ¾″ 344 MCF 38°	‡2400 GOR 1170	Perf. 40 at 12,210 to 12,220′. Discovered new sand. DT 162 days.
13,250	10-19-48 12-31-47	Gulf 1 Mainka	Vierson & Cochran Okmulgee, Okla.	Northeast Bradley, Grady, Okla.	Bromide Bromide	7″ 26* and 29* at 13,140′, 1000 sx	470B 11/64″ 790 MCF 46.5°	‡2400, §2700, ^2600, °6000, +12,030, 206F GOR 1700	Wildcat. Discovered Northeast Bradley field. DT 270 days. 187 bits. Plan to deepen.
13,285	3-10-48 12-23-47	Union of Calif. 1 State L. L. & E., Unit 8	Loffland Bros., Houston, Tex.	Bay Junop, Terrebonne, La.		16″ at 169′, 200 sx; 10¾″ 40.5* at 2985′, 1500 sx	Dry		Wildcat. DT 77 days. 50 bits.
13,303	6-24-48 11-11-47	Stanolind 1 Robt. D. Trahan	Falcon Seaboard Drlg. Co., Houston, Tex.	E. Florence Vermilion, La.		10¾″ 40.5* CSA 2994′; 7″ 32* and 29*, CSA 11,096′	Dry		Wildcat. DT 138 days. 106 bits.
13,316	11-14-48 7- 3-48	Humble C-1 La. Furs	Company rig	West Esther, Vermilion, La.		20″ 48* at 91; 13⅜″ 61* at 1901; 9⅝″ at 9000′			Wildcat. DT 139 days. 77 bits.
13,335	2-27-48	Placid 1 Walters	Penrod Drlg.	Jones, Miss.					
13,359	5-13-48 7-11-47	Stanolind 1 J. E. Mabee	Guy Mabee	Martin, Tex.	Ellenburger	9⅝″ 36* and 32.3* CSA 3991′	Dry		Wildcat. DT 307 days. 151 bits.
13,427	2-11-48 11- 2-47	Humble 2 Saus Ranch-Tenerias	Company rig	Saus Ranch, Willacy, Tex.		20″ at 85′; 13⅜″ at 2994′; 9⅝″ at 8608′	Dry		Wildcat. DT 109 days. 63 bits.

*Pressure is indicated by °flowing casing, ‡flowing tubing, §shut in casing, ^shut in tubing, °initial reservoir, +datum.

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DESCRIPTIONS OF WELLS DRILLED BELOW 12,000 FT IN 1948

TD, ft PB, ft	Complt'd Spudded	Company and name of well	Drilled by	Field and location	Deepest form. Prod. form.	Casing and cementing schedule	Init. prod., grav., choke	Pressure*, GOR	Remarks
13,468	1- 5-48 6-28-47	Texas 5 City of N. Orl'ns	Hillburn Drlg. Co.	Leeville Lafourche, La.	Sand Sand	10¾" at 2681' 500 sx; 7" at 11,096' 1000 sx; 5" at 13,408' 150 sx	146B ¼" 47.9°	‡1400 GOR 11,721	Wildcat. Extension. Discovered new sand. Perf. 30 at 12, 980-985'.
13,471	10-13-48 7-22-48	Tide Water 1 Lafourche Rlty.		Plaquemines, La.	Shale	20" at 102' 200 sx; 13⅜" at 2010' 800 sx; 9⅝" at 8454' 1000 sx	Dry		Wildcat. DT 82 days.
13,497	3-15-48 9-21-47	Humble 1 Humble Fee-Gulf	Company rig	Weeks Island, Iberia, La.		20" 48* at 85'; 13⅜" at 2580'; 9⅝" at 11,388'	250B ⅛" 155 CF 24.8°	‡1000 GOR 600	Wildcat. Extension. DT 175 days. 69 bits.
13,503	3- 9-48 5- 3-47	Gulf 3-A W. H. Smith-R. S. Jackson "A"-3	L. D. Cain Drlg. Co., Houston, Tex.	Fannett, Jefferson, Tex.	L. Frio L. Frio	110' of 20" SW 48*, 160 sx; 1778' of 13¾" SS 54.5*, 800 sx; 3140' of 9⅝" SS 47*; 5172' of 9⅝" SS 43.5*, 800 sx; 3848' of 5½" SS 20*; 7292' of 5½" SS 17°, 550 sx; 10,996' of 2" SS 4.7*	126B ¾" 6,219,919 CF 47°	‡3250, ^4255, °5385,•11,050 190 F GOR 49,365 Present reservoir pressure, 4255	Wildcat. Extension. DT 285 days. 139 bits.
13,524	5-27-48 7-20-47	Amerada 2 H. S. Record	Rowan Drlg. Co., Ft. Worth, Tex.	Monument, Lea, N. Mex.	Devonian	245' of 16" 65*; 4443' of 11¾" 47*	Dry		Wildcat. DT 310 days. 328 bits. DST taken to 13,508'.
13,524 Old TD 11,157	5-19-48 12-23-47	Gulf & Placid 1 B. L. Sholar	Lyle Cashion, Inc. Laurel, Miss.	Jones, Miss.		52' of 20" 78.6*, 100 sx; 1609' of 13⅜" 54.5* and 61*, 1000 sx	Dry		Abandoned by Gulf at 11,157.' Deepened by Placid to 13,524'. Wildcat.
13,530	9- 7-48 2-27-48	Chicago Corp., 1 Eli Heinsohn	Loffland Bros., Tulsa, Okla.	Corpus Christi, Nueces, Tex.	Frio	16" at 64'; 10¾" at 2357'; 7" at 9995'; 5" at 13,159'			Discovered new sand. Produc-duction from 8600'. DT 132 days.
13,570	1-29-48 10-16-47	Union Prod. 3 Buckley-Bourg	Loffland Bros.,	Delarge, Terrebonne, La.	Miocene	16" 55* at 171' 125 sx; 10¾" 51* at 1209', 10¾" 51* at 1961', 40.5* at 4502' 1500 sx	Dry		Wildcat. DT 68 days.
13,603	7-15-48	McCarthy 1 E. H. Niedring-haus		, Tex.			¼"		
13,628	7- 2-48 8-23-47	Superior1-AState Gulf of Mexico	Company rig	Vermilion Block 71, Vermilion, La.	Miocene Miocene	20" at 168'; 13⅜" 54* at 2530' 1425 sx & 75 sx at top; 9⅝" 53.5* & 47* at 10,163' 1200 sx; 7" 29* & 35* at 12,926' 450 sx	53B 36/64" 5911 MCF 51.4°	‡3790 GOR 110,838	Wildcat. Discovered new field. Perf. 9608-9618'. DT 115 days
13,636	11- 7-48 10-11-47	Magnolia 1 State lse 838, blk 45	Company rig	(Gulf of Mexico), Iberia, La.	Sdy. sh.	20" at 420'; 13⅜" at 2328'; 9⅝" at 8207'	51B ½" 45.5°	‡920 GOR 180,000	Wildcat.
13,687	4-29-48	Texas 12 State- Cote Blanche Is.	Company rig	Cote Blanche Island, St. Mary, La.	Sh. Sand	13⅜" at 2494' 600 sx; 8⅝" at 12,094' 1200 sx; 5½" at 13,386' 275 sx	½" 7700MCF	‡2250, ^4800	Wildcat. Discovered Cote Blanche Is. field. Perf. 13,300-58'.
13,741	7-15-48 3- 8-48	Texas 2 Mary S. Nelson	Cron & Gracey Drlg. Co. Houston, Tex.	Point-au-Fer, Terrebonne, La.	Shale	13⅜" at 1825' 550 sx; 9⅝" at 12,014' 1250 sx	Dry		Wildcat.
13,760	7-19-48 1-21-48	Texas 20 Sunset Realty & Planting Co.	Loffland Bros. Tulsa, Okla.	Paradis, St. Charles, La.	Salt Sand	13⅜" at 3034' 1000 sx; 8⅝" at 11,281' 1000 sx; 5½" at 1250' 275 sx	48B 1641 MCF 51.8°		Wildcat. Extension. Discovered new sand. Perf. 241 at 11,042-102'.
13,822 12,800 9450	3-19-48	Gulf 1-E W. Bryant	Rowan Drlg. Co., Ft. Worth, Tex.	Midland, Tex.	Ellenburger	2500' of 29*; 1400' of 26*; 2000' of 23*; 2100' of 26*; 3100' of 29*			DT 233 days. 212 bits.
13,823	6- 8-48 7-10-47	R. W. Norton, Jr. 5DantslerLbr.Co	H. I. Morgan, Shreveport, La.	Stone, Miss.		60' of 16*, 60*; 2490 of 10¾" 40.5*	Dry		Wildcat. 74 bits. DT 233 days. Deepened 4-8-48 from 11,502'.
13,825		Placid 1 Otho Shows	Penrod Drlg. Co.	Jones, Miss.			Dry		
13,857	10-24-46 6-17-48	Placid 1 DuPont		Lapeyrouse, Terrebonne, La.	Miocene sd. Miocene	13⅜" at 2675'; 7" at 12,303'; 3½" at 12,076'	11B 12/64" 3235MCF 60°	°3840, ‡4700 GOR 29,050	
13,977	9- 3-48 1- 2-48	Wilshire 1 McElroy	Louis Mabee and Wilshire rig, Midland, Tex.	Wilshire Upton, Tex.	Ellenburger Wolfcamp	13⅜" at 557'; 9⅝" 36.6* at 5195', 1500 sx; 5½" 17* and 20* at 10,797, 800 sx	240B 35 MCF	°2850, §1200	Wildcat. Discovered Wilshire field. Perf. 200 at 7750-8000'.
14,000	3-29-48 11-15-47	Humble 2 J. M. Burquieres Co.	Ballew Drlg.	St. Mary, La.		20" at 72'; 13⅜" at 1132'; 9⅝" at 8827'	Dry		Wildcat. DT 140 days. 96 bits
14,000	12-22-47 9- 9-47	[2]Shell 1 Smith- State Unit B	Company tools	Weeks Island, Iberia, La.		16" at 120'; 10¾" at 4506'; 7" at 13,999'	476B 630 CF 33°	GOR 1340	DT 92 days. 65 bits. Pierce-ment type salt dome. Perf. 64 at 13,846-62'.
14,004 8,453	3-10-44 10-24-43	[1]Shell 11 Central Coal&CokeCorp.	Company tools	Mercy, San Jacinto, Tex.	Shale	16" at 40'; 10¾" at 2999' 400 sx; 7⅝" at 8587' 500 sx	13.7B 38°		Perf. 16 at 8372-77'
14,023	7-30-48 2- 7-48	Texas 1 Cameron County Water & Imprvm't Dist 5	J. C. Hawkins Co.	Cameron, Tex.		13⅜" at 1087'; 720 sx; 9⅝" 43.5* at 7504', 800 sx	Dry		Wildcat. DT 174 days.
14,065	9-28-48 5-25-48	Superior 1 M. G. Johnson	Company rig	Matagorda, Tex.	Frio	20" at 82' 280 sx; 11¾" 47* at 1484' 937 sx; 7⅝" 39* & 33.7* at 11,171' 1000 sx	Temp. aban-doned.		Wildcat. DT 105 days.
14,137	9-26-48 3-18-48	Texas C-1 Bay St.Elaine, lse1246	Company rig	Bay St. Elaine, Terrebonne, La.	Sh. & lime Sand	10¾" at 2027' 500 sx; 7" at 12,005' 1000 sx; 5" at 14,137' 180 sx	78B 1/16" 2885 MCF 47.3°	‡4500 GOR 36,984	Wildcat Extension. Discover-ed new sand. Perf. 332 at 13, 718-64'.
14,147	2-26-48 9-24-47	Stanolind 2 State lse 739	Noble Drlg. Corp., Tulsa, Okla.	S. Timbalier Bay, Terrebonne, La.		13⅜" 54.5* and 61* CSA 2502'; 9⅝" 40* and 53.5* CSA 6940'	Dry		Wildcat. DT 152 days. 48 bits
14,251	9-10-48 4-22-48	Texas et al 1-D Point-au-Fer	Loffland Bros.	Point-au-Fer, Terrebonne, La.	Sh. & Sd.	13⅜" at 1398' 500 sx; 9⅝" at 12,153' 1250 sx	Dry		Wildcat.
14,296	6- 5-48 1-17-48	Superior 4 Cont. Ld & Fur	Company rig	Bayou Penchant, Terrenonne La.	Miocene	18" at 146' 250 sx; 13⅜" 53.5* at 1952' 1250 sx; 9⅝" 53.5* at 11,009' 1200 sx	Dry		DT 120 days.

*Pressure is indicated by °flowing casing, ‡flowing tubing, §shut in casing, ^shut in tubing, •initial reservoir, *datum.

[1]Deep well not included in previous surveys. [2]Well listed, but not described in 1947 survey. [3]1944 deep well deepened in 1948.

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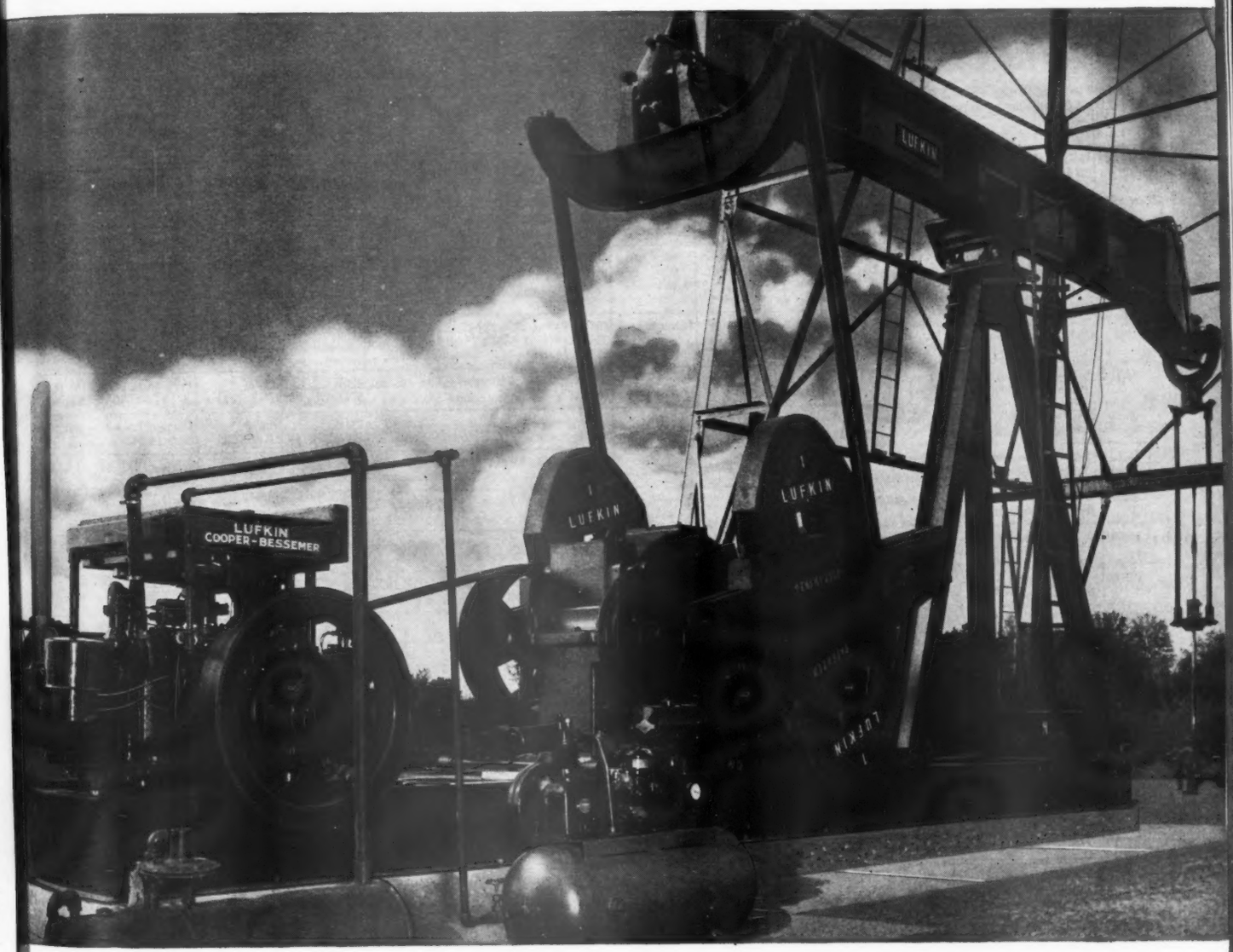

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DESCRIPTIONS OF WELLS DRILLED BELOW 12,000 FT IN 1948

TD, ft PB, ft	Complt'd Spudded	Company and name of well	Drilled by	Field and location	Deepest form. Prod. form.	Casing and cementing schedule	Init. prod., grav., choke	Pressure*, GOR	Remarks
14,309	7–10–48 8–17–47	Pure 1 West Poison Spider Unit	Loffland Bros., Tulsa, Okla.	Natrona, Wyo.	Frontier Frontier	13,791′ of 7″ SS 35*, 32* and 29*	898B ¾″ 1800 MCF 43.6°	⊖200, ‡140, *5823, +8350, 226 F GOR 2004 Present reservoir pressure, 5823	Wildcat. Discovered new field. Anticline. 187 bits. Production from 14,309′. Deepest oil production in Wyoming.
14,318	7–10–48 10–23–47	Texas 1 Dugas & LeBlanc Ltd.	Falcon Seaboard Drlg. Co. Houston, Tex.	Napoleonville, Assumption, La.	Shale	11¾″ at 2795′ 500 sx; 7⅝″ at 12,021′ 1000 sx; 5″ at 12,602′ 120 sx	Dry		Wildcat.
14,413	4– 7–48 6–12–47	Texas 2 Realty Operators	Wheless Drlg. Co.	Convent, St. James, La.	Sd. and sh.	13⅜″ at 2959′, 500 sx; 8⅝″ at 11,485′, 1000 sx	Plugged and abandoned		
14,444	5–15–48 10–13–47	Standard of Calif. 1-1 Houghton Comm.	Rocky Mt. Drlg. Co., Los Angeles, Calif.	Santa Fe Springs, Los Angeles, Calif.	Miocene		Dry		Wildcat. DT 215 days. Anticlinal nose or flank.
14,465 Old TD 13,586 11,575	9–15–48 3–25–48	[3]Union Prod. 2 Buckley-Bourg	Loffland Bros.,	Delarge, Terrebonne, La.	Miocene	7″ 32* at 13,631′, 125 sx	Dry		Wildcat. DT 172 days. Depleted oil well reworked and completed as dry hole.
14,473	7–26–48 2–19–48	Texas 111 LL&E Leeville	Hillburn Drlg. Co.	Leeville, Lafourche, La.	Sh. & lime Sand	13⅜″ at 2612′ 500 sx; 9⅝″ at 11,529′ 1000 sx; 7″ at 14,173′ 129 sx	319B ½″ 28°	‡2100 GOR 703	Wildcat. Extension. Discovered new sand. Perf. 14,082-75′.
14,498	11– 4–48 7– 3–47	Texas 1 Yates	Parker Drlg. Co., Tulsa, Okla.	Caddo, Okla.		13⅜″ at 1347′, 1400 sx; 9⅝″ at 6001′, 900 sx	Dry		Wildcat. DT 490 days. 290 bits.
14,513	12–27–48 9– 4–47	Barnsdall RSF 66-9	Company rig	Newhall-Potrero, Los Angeles, Calif.		401′ of 13⅜″; 7″ 31*, 29*, 26*, and 23* at 10,668′; 4½″ 16.6* at 14,505′	50B 28°	⊖700, ‡110	Discovered new sand. Perf. 2660 shots at 13,940′-14,505′. Deepest production in world in 1948. Anticline.
14,553	4–11–48 8–10–47	Humble 1 State Calcasieu Lake, lease 1256	Company rig	Cameron, La.	Discorbis	20″ SS 94* at 177′; 13⅜″ SS 61* at 2583′; 9⅝″ SS 40* at 8553′; 7″ SS 26*, 29* and 32* at 14,018′	Dry		Wildcat. DT 244 days. 126 bits.
14,704	6–12–48 1– 4–48	Shell B-2 Smith-State	Company rig	Weeks Island, Iberia, La.		10¾″ at 4490′, 750 sx; 7⅝″ at 14,225′, 750 sx	470B 574MCF 33°	‡2400 GOR 1221	Perf. 58 at 14,015-18′, 14,022-26′, 14,030-40′. Salt dome.
15,094	11–30–48 7–12–48	Shell A-1 J. A. Smith	Company tools	Weeks Island, Iberia, La.			431B 472 MCF 34°	‡2575 GOR 1095	Deepest Louisiana production from 14,243-55′.
15,184 13,740	11–25–48 10– 7–46	Stanolind 1 Briscoe Unit	Kerr-McGee	Southwest Bradley, Grady, Okla.	Arbuckle	9⅝″ 40*, 43.5* CSA 6960′; 7″ 23* CSA 13,670′	Dry		Wildcat. DT 527 days. Anticline.
15,549	2– 2–48 6–26–47	[3]Texas 6 State Atchafalaya Bay	Company rig	Belle Isle, St. Mary, La.	Sh. with Sd.	13⅜″ at 2495′ 750 sx; 8⅝″ at 10,844′ 1600 sx	Dry		Wildcat.
15,604	9–12–48 3–11–48	Texas 1 State lse 646	Company rig	Queen Bess Island, Jefferson, La.	Shale	13⅜″ at 2024′ 500 sx; 8⅝″ at 12,003′ 1000 sx	Dry		Wildcat.
16,106	8–22–48 8–17–47	Texas 4 State Barataria	Company rig	Queen Bess Island, Jefferson, La.	Sd. & Sh.	13⅜″ at 3017′ 500 sx; 8⅝″ at 12,027′ 1000 sx; 5½″ at 16,106′ 750 sx	Dry		Wildcat.
17,094		[3]Denver Prod. & Ref. 1 School Ld. Bd.		Caddo, Okla.			Shut in		Second deepest hole in Oklahoma.
17,696	2–12–48 6– 6–47	[3]Standard of Calif. 1 Maxwell	Rocky Mt. Drlg. Co. Los Angeles, Calif.	W. Montalvo Ventura, Calif.	Repetto silt		Dry		DT 251 days. Deepest hole in California. Second deepest in world.

*Pressure is indicated by ⊖flowing easing, ‡flowing tubing, §shut in casing, ^shut in tubing, ©initial reservoir, +datum.

[3]Well listed, but not described in 1947 survey.

This record was held only a few weeks when in July, Pure No. 1 West Poison Spider discovered a new field near Casper, Wyoming, at 14,309 ft. It had good production, too, 898 bbl 43.6 gravity and 1,800,000 cu ft of gas on ¾-in. choke.

As the end of the year came, Barndall No. 66-9 RSF picked up a new deep sand in the Newhall-Potrero field, California, reaching to 14,505 ft, according to company report, and producing 50 bbl a day of 28 gravity oil on gas lift.

The other two wells producing from below 14,000 ft are both in Louisiana. The Texas No. 111 Louisiana Land and Exploration at Leeville in July, 1948, discovered a new sand at 14,082-94 ft good for 319 bbl 28 gravity flowing through ⅛-in. choke. Shell No. A-1, J. A. Smith had 431 bbl 34 gravity oil and 472,000 cu ft gas from 14,243-55 ft in Weeks Island. This is the same sand that has been producing so handsomely at the salt dome structure since 1945.

One of the interesting phases of this deep production is the low gravity in the Barnsdall and the Texas wells.

Of the 62 deep wells drilled this year that found oil, only one is producing above 8000 ft. This is the Texas 1-B Harrell with a total depth of 12,196 ft, a wildcat that discovered new gas and condensate production at 5035-5120 ft in Stephens County, Oklahoma.

The 61 other producing depths are divided thus:

6 in 8000- 9000-ft group
7 in 9000-10,000-ft group
5 in 10,000-11,000-ft group
14 in 11,000-12,000-ft group
19 in 12,000-13,000-ft group
5 in 13,000-14,000-ft group
5 in 14,000-15,000-ft group

Wildcats

Most of the wells drilled below 12,000 ft are wildcats, semi-wildcats, and field wildcats (meaning exploring deeper sands in old fields) and this condition will continue as the drill goes deeper. In 1948 about 65 per cent of all deep wells completed were in this category. These 97 tests

Table 4. Wells drilled below 12,000 ft in 1948 but not completed.

Present depth, ft	Condition	Company and name of well	Field and location
12,000	Testing	Magnolia 1 Britt-Chitwood Unit	Chitwood, Grady, Okla.
12,000	Testing	Magnolia 2 A. V. Spiers	Chitwood, Grady, Okla.
12,020	Testing	Western Nat. Gas 9 St. Charles Ranch	St. Charles, Aransas, Texas
12,030	Drilling	Texas 22 Falgout Holding Co.	Texas, Terrebonne, La.
12,040	Drilling	Barnsdall 1-A State	Chaves, N. Mex.
12,100	Drilling	Humble 1 Liverpool Gas Unit	Brazoria, Tex.
12,131	Testing	Marine Exploration 2 State	Seal Beach, Los Angeles, Calif.
12,213	Testing	Gravis & Mitchell 1 Opdenweyer Alcus	St. Gabriel, Iberville, La.
12,263	Drilling	Magnolia Santa Fe Pacific "C"	Lea, N. Mex.
12,285	Testing	Gulf 1 La. State lse 1304	Jefferson, La.
12,432	Drilling	Humble B—4 J. M. Burguieres	Weeks Island, Iberia, La.
12,485	Drilling	Mid-Continent 1—B U. D. Sawyer	Lea, N. Mex.
12,527	Testing	Magnolia 1 F. Dodson	Chitwood, Grady, Okla.
12,527	Drilling	Ohio 3 Sledge	Knox, Grady, Okla.
12,699	Drilling	Texas 6 City of New Orleans	Leeville, Lafourche, La.
12,799	Drilling	Stanolind 1 Unit Big Sand Coulee	Park, Wyo.
12,922	Drilling	Standard of Calif. 4—2 SF&FL	Kettleman Hills S. Dome Kern, Calif.
12,950	Testing	British-American 1 Hartmann-Barnard Unit	Ventura Ave., Ventura, Calif.
13,033	Testing	Mountain Fuel Supply 5 Unit	Church Buttes, Sweetwater, Wyo.
13,087	Drilling	Magnolia 1—A TXL	Upton, Tex.
13,116	Drilling	Texas 1 Scharbauer	Midland, Texas
13,540	Testing	Standard of Calif. 12—21 KCL	Greeley, Kern, Calif.
13,655	Fishing	Societe Nationale des Petroles d'Aquitaine 1 Bastennes-Gaujac	South of Dax, France
13,885	Drilling	Superior 1 Harris, Tex.	Houston, Harris, Tex.
14,003	Testing	Richfield 21-33 CLA	N. Coles Levee, Kern, Calif.
14,039	Testing	George Vasen 1 Fee	Stone, Miss.
14,450	Drilling	Superior 4 LL&E State Unit 12	Four Isle, Terrebonne, La.
14,451	Drilling	Kerr-McGee et al Block 28	(in Gulf of Mexico), Terrebonne, La.
14,640	Drilling	Superior, Pacific Creek	Sublette, Wyo.
14,910	Drilling	Texas B—2 State lse 1248-Lake Pelto	Terrebonne, La.
15,003	Testing	Texas 1 State lse 919	Leeville, Lafourche, La.
15,033	Drilling	Superior 3 S. Tex. Dev. Co.	Lake Creek, Montgomery, Tex.
15,150	Drilling	Humble 2 J. R. Williams	Washington, Ala.
16,347	Testing	Humble 1 McWatters	Freestone, Tex.

brought in 17 brand new fields and 22 new sands or extensions, or a total of 39 strikes out of 97 tries, better than one in three.

This is a considerably higher percentage of discoveries than the average but the deep well is like several wells in the area it tests.

Many of these new fields were of first importance. Mid-Continent's Crossroads field, in Lea County, New Mexico, was the first production below 12,000 ft in the state. The location was made by seismograph and drilled to 12,258 ft. The Ellenburger was found at 12,115-255 ft and flowed an initial production of 3980 bbl 42.5 gravity oil a day through a 24/64-in. choke.

Pure's West Poison Spider field, Natrona County, Wyoming, mentioned before, is another great discovery.

Alberta, Canada, got one of the newfound fields. Canadian Gulf discovered the Pincher Creek field at 11,755 ft with a well that went to 12,516 ft. The initial production was 385 bbl condensate and 9,800,000 cu ft gas; it is now shut in.

Fields Below 12,000 Ft

Fourteen new pools were opened up below 12,000 ft in 1948. Louisiana had 6 of these; California, Texas, and Wyoming each 2; New Mexico and Oklahoma each one.

This makes to date 32 fields deeper than any drill ever went before 1935, and more than a third of them were discovered in 1948.

Some of these are shut in awaiting further development or market outlets but most of the new ones are on production.

The new deep discoveries are shown on the map and described in detail in the tables. They include:

California. Barnsdall No. 66-9, RSF Newhall-Potrero field, mentioned above, and Standard of California No. 73-30 V Bolsa Chica, Kettleman Hills, which was worked over and deepened before it was brought in for 530 bbl a day and 5,230,000 cu ft gas.

Louisiana. Superior discovered a new sand at Four Isle with its No. 1 LLE State Unit No. 19. Initial production was 294 bbl 38 gravity oil and 344,000 cu ft gas.

The Texas No. 12 State-Cote Blanche Island found a new gas field in St. Mary Parish below 13,300 ft, which is now shut in. The same company found two new sands in Leeville field, another one at Rabbit Island, and one at Bay St. Elaine.

New Mexico. The spectacular Crossroads* find has already been discussed.

Oklahoma. Gulf No. 1 Mainka discovered production below 13,000 ft in Grady County. Initial output was 470 bbl 46.5 gravity and 790,000 gas through 11/64-in. choke. The well was allowed to produce 2 months before plans were made to deepen it.

Texas. In the South Mayes field Humble discovered a new sand, which tested 134 bbl condensate and 1,334,000 cu ft gas. The well is shut in.

The Slick Urschel Benedum field properly belongs in 1948 completions also.

Wyoming. Pure's West Poison Spider find and the extension of the Church Butte field of Mountain Fuel Supply are two deep discoveries of importance. The Frontier sand at West Poison Spider, which is producing, is over a hundred feet thick. The Church Butte well produced some 29,600,000 cu ft of gas from the Dakota sand, which is 230 ft thick. This is shut in awaiting outlet.

Development Wells

Most intensive development of deep fields was at Ventura Avenue, California, and Week's Island, Louisiana.

Tide Water drilled 8 producers in the Ventura Avenue field, 3 of which were deepened to the new deep sand discovered in 1947. These had good initial production of some 1000 bbl 32 gravity oil on the average with about 1,000,000 cu ft gas.

Five new producers were drilled by Shell at Weeks Island. They average some 400 bbl 34 gravity oil a day initial output and about 400,000 cu ft gas.

Table 5 shows the consistent trend toward deeper drilling in the last five years. Only in the deepest zones is there wavering in the line.

Two new deep wells joined the Superior Weller test to make three more

*See "Drilling Problems in New Crossroads Field," by K. Marshall Fagin, *The Petroleum Engineer*, July, 1948, page 55, for details on this field.

Table 5. Wells by depth zones.

	12,000 to 13,000	13,000 to 14,000	14,000 to 15,000	15,000 to 16,000	16,000 to 17,000	17,000 to 18,000
1944	32	3	2	0	1	0
1945	50	10	5	3	1	0
1946	67	20	8	1	0	0
1947	71	23	13	5	2	1
1948	82	39	17	4	1	2
Totals	302	95	45	13	5	3

than 17,000 ft deep. Denver Producing and Refining has shut in its 17,094-ft test in Caddo County, Oklahoma, and Standard of California's Maxwell test was dry at 17,696 ft.

Superior Oil Company may be on the way to outdoing its own record at the Sublette, Wyoming, location where a new rig capable of drilling to 20,000 ft is being given its first trial and has already drilled the deepest hole in the state.

Drilling Time

Know-how has undoubtedly speeded up drilling time, which has reduced expense. Heavy drilling rigs that can handle the heavier and longer drill collar strings are another important factor in shortening drilling time. In 1947 average drilling time for 119 completed wells was 180 days. In 1948 it was 162 days average for 149 wells, theoretically 18 days off each operation.

This reduction is made in spite of the fact that twice as many wells were drilling for more than a year in 1948 as there were in 1947. No operation in 1948 bettered the 24-day drilling time record made by Humble No. 1 P. H. McKnight, a wildcat that went to 14,629 ft in Wood County, Texas.

Union of California No. 1 R. W. Collins, Houma field, Louisiana, development well, went to 12,153 ft in 23 days for the 1948 record.

The Louisiana well that had 526 days drilling time, Gulf La Fourche Levee District Unit No. 18 stuck drill pipe at 11,871 ft and at 11,457 ft and had to side track above each time.

Another time consuming but valuable operation are the cores taken and drillstem tests.

The above Gulf well took 92 sidewall tests and 32 core bbl tests. Besides taking 19 cores Amerada No. 2 H. S. Record, Lea County, took 13 drillstem tests between 5485 ft and 13,508 ft. Over a hundred tests,—Schlumberger Sidewall, A-1 sidewall, Hughes, or wire lime—are not exceptional.

Bits

There is a discernible reduction in number of bits used in deep drilling. There is enough experience in this type of operation now to get more use out of a bit and the bits themselves have been much improved. Stronger metals and better bearings give modern bits more authority.

In 1947 an average of 112 bits per well were needed in wells below 12,000 ft in the U. S. and Canada. This came down to an average of 96 in 1948 despite greater average depth of the wells.

This is also true of various localities. Average number of bits used per deep well in Louisiana was 71 in 1947 and 62 in 1948. One well used only 2 rock bits and 17 drag.

Texas shows a larger reduction with an average 106 bits per well compared to 130 in 1947.

A slight increase is found in California where 183 bits per well was average in 1947 and 199 in 1948. California, The Rocky Mountain district, and Canada drilling reveals its difficulties in the higher number of rock bits necessary to cut the dense formations.

Distribution

Louisiana continues to lead in number of wells drilled below 12,000 ft with 81 added this year to make 289 in the state.

California retained its place as second with 16 added to bring the total to 109. Last year, however, California drilled 24 below 12,000 ft.

Texas had 25 new deep wells to 20 last year and now has a total of 106.

Oklahoma now has 19 deep wells; Mississippi has 16; Florida 7; Wyoming, and Canada, 6 each; New Mexico, 5; Colorado, with none added in 1948, has 2.

Russia reports a second well below 12,000 ft in 1948 and Venezuela has 2 old ones. Canada, Russia, and New Guinea each had one deep well in 1948, the only ones outside the United States.

Operators

Each year a number of new operators are added to the list who are pioneering in the depths of the earth. According to the records 85 operators have drilled one or more wells below 12,000 ft. This represents a wide and varied management even for the substantial number of 610 wells drilled.

Eleven companies completed their first deep one this year.

This is the first time the name of the drilling contractor has been added to other information about deep wells. Here again we have a large number that have become familiar with deep drilling operations. More than 60 per cent of the 1948 wells were drilled by contractors; the other part by company divisions. * * *

TABLE 6. Deep wells (12,000 ft or below) by location.

State and County or Parish	Prior to 1948	1948	Total
Alabama	1	0	1
Clarke	1	0	
California	93	16	109
Fresno	3	0	
Imperial	1	0	
Kern	61	3	
Kings	3	1	
Los Angeles	8	2	
Orange	2	0	
Tulare	2	0	
Ventura	13	10	
Colorado	2	0	2
Rio Blanco	2	0	
Florida	6	1	7
Charlotte	1	0	
Collier	1	1	
Highlands	1	0	
Monroe	2	0	
Palm Beach	1	0	
Louisiana	208	81	289
Acadia	4	0	
Allen	1	0	
Ascension	2	0	
Assumption	4	2	
Beauregard	4	0	
Bossier	1	0	
Calcasieu	3	2	
Cameron	7	6	
Claiborne	1	1	
Evangeline	13	0	
Iberia	24	10	
Iberville	3	2	
Jackson	1	0	
Jeff Davis	6	0	
Jefferson	12	5	
Lafayette	2	2	
Lafourche	12	11	
Plaquemines	17	5	
Rapides	1	0	
St. Bernard	2	1	
St. Charles	4	3	
St. James	0	1	
St. John the Baptist	1	0	
St. Landry	1	2	
St. Martin	8	3	
St. Mary	20	7	
Terrebonne	32	12	
Vermilion	18	6	
Vernon	1	0	
Washintgon	1	0	
Webster	2	1	
Mississippi	11	5	16
Adams	4	0	
Forrest	2	0	
Green	1	0	
Jasper	0	1	
Jeff Davis	1	0	
Jones	1	3	
Lincoln	1	0	
Rankin	1	0	
Stone	0	1	
New Mexico	2	3	5
Lea	1	3	
Chaves	1	0	
Oklahoma	10	9	19
Beckham	1	0	
Caddo	1	3	
Dewey	2	0	
Garvin	0	2	
Grady	3	3	
McClain	1	0	
Stephens	1	1	
Washita	1	0	
Texas	81	25	106
Anderson	2	0	
Andrews	2	0	
Brazoria	12	2	
Brazos	1	0	
Brooks	1	1	
Cameron	1	1	
Chambers	2	1	
Colorado	1	0	
Crane and Upton	1	0	
Duval	1	0	
Ector	2	0	
Freestone	1	0	
Gaines	3	0	
Galveston	2	1	
Goliad	1	0	
Gonzales	1	0	
Grayson	1	0	
Hardin	2	0	
Harris	4	0	
Houston	0	1	
Jackson	1	0	
Jefferson	1	2	
Kenedy	1	0	
Liberty	3	1	
Madison	1	0	
Martin	0	1	
Matagorda	4	2	
McMullen	1	1	
Midland	1	2	
Montgomery	8	0	
Newton	1	0	
Nueces	1	3	
Pecos	3	0	
Reeves	1	0	
San Jacinto	0	1	
Shelby	1	0	
Smith	2	0	
Starr	1	0	
Trinity	1	0	
Titus	1	0	
Upton	1	4	
Willacy	3	1	
Winkler	2	1	
Wood	1	0	
Utah	1	0	1
Carbon	1	0	
Wyoming	4	2	6
Freemont	1	0	
Natrona	0	1	
Sweetwater	1	1	
Uinta	2	0	
The Bahamas	1	0	1
Canada	5	1	6
Ecuador	1	0	1
France	1	0	1
Germany	1	0	1
New Guinea	0	1	1
Russia	1	1	2
Venezuela	2	0	2
Total	431	145	576

Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA CITY • NEW YORK

OUR 28th YEAR

Now available in TWO TYPES...

The BAASH-ROSS POWER SWIVEL

Constant speed — Constant torque
Variable speed — Variable torque

Complete...

No Rotary Table or Auxiliary Equipment Necessary!

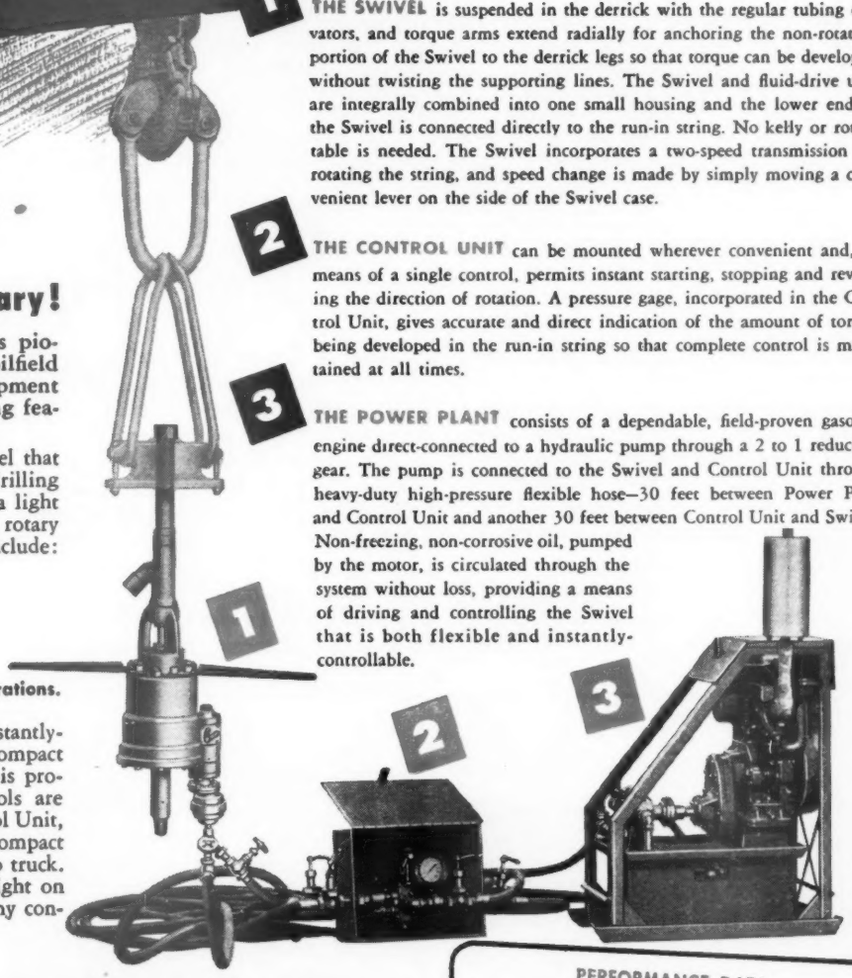
From the same organization that has pioneered so many important advancements in oilfield equipment, comes another *really new* development that has many unique money and time-saving features. It is the Baash-Ross Power Swivel.

This unit consists of a fluid-driven Swivel that can be suspended in the rig—*any* rig, whether drilling or producing—to provide a means of rotating a light string of tools without need for installing kelly, rotary table or other heavy equipment. Applications include:

- **Internal cutting and fishing jobs**
- **Drilling out bridges**
- **Scraping liners**
- **Drilling out cement in tubing**

...and other similar operations.

The Swivel is driven by positive, instantly-controlled hydraulic pressure generated by a compact Power Unit, and continuous finger-tip control is provided by a Control Unit in which all controls are centralized. The entire assembly—Swivel, Control Unit, Power Plant and connecting equipment—is so compact it can be readily transported in a small pick-up truck. And if desired, the Power Plant can be left right on the truck for quick jobs—or can be set off at any convenient place on or near the rig.



1 **THE SWIVEL** is suspended in the derrick with the regular tubing elevators, and torque arms extend radially for anchoring the non-rotating portion of the Swivel to the derrick legs so that torque can be developed without twisting the supporting lines. The Swivel and fluid-drive unit are integrally combined into one small housing and the lower end of the Swivel is connected directly to the run-in string. No kelly or rotary table is needed. The Swivel incorporates a two-speed transmission for rotating the string, and speed change is made by simply moving a convenient lever on the side of the Swivel case.

2 **THE CONTROL UNIT** can be mounted wherever convenient and, by means of a single control, permits instant starting, stopping and reversing the direction of rotation. A pressure gage, incorporated in the Control Unit, gives accurate and direct indication of the amount of torque being developed in the run-in string so that complete control is maintained at all times.

3 **THE POWER PLANT** consists of a dependable, field-proven gasoline engine direct-connected to a hydraulic pump through a 2 to 1 reduction gear. The pump is connected to the Swivel and Control Unit through heavy-duty high-pressure flexible hose—30 feet between Power Plant and Control Unit and another 30 feet between Control Unit and Swivel. Non-freezing, non-corrosive oil, pumped by the motor, is circulated through the system without loss, providing a means of driving and controlling the Swivel that is both flexible and instantly-controllable.

TWO TYPES...MANY APPLICATIONS

To meet the various requirements of different operators, the Baash-Ross Power Swivel is available in two types . . .

1. **MODEL "F" which provides a choice of two rotating speeds as indicated at right, and in each speed both the torque and RPM remain practically constant at all times.**
2. **MODEL "FV" which provides two speed ranges, and in each range both the torque and RPM are variable between wide limits as indicated at right.**

Since the Power Swivel requires no drawworks or other heavy equipment that is complicated and costly to install, it is ideal for many light rotating jobs—for drilling out cement plugs and sand bridges, for scraping paraffine, for rotating internal cutters, etc.

On cutting jobs its smooth, sensitive, easily-controlled hydraulic drive is far superior to the irregularities and uneven feed of manual rotation. It is also safer because there is no need for workmen to be near the stretched pipe while it is being cut . . . nor for them to work on makeshift platforms. The Power Swivel can be operated at any height in the rig, eliminating need for cutting off the run-in string at floor level.

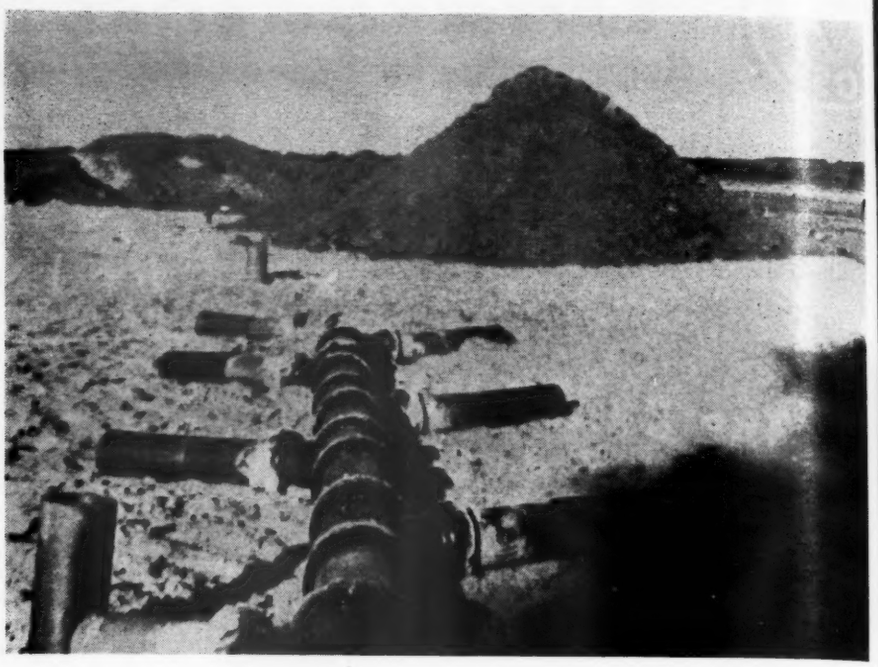
PERFORMANCE DATA

Swivel
Capacity—80,000 lbs. Tensile Loading.
Speed
Model "F", 17 RPM—constant—low speed
34 RPM—constant—high speed
Model "FV", 1 to 17 RPM—variable—low speed.
1 to 34 RPM—variable—high speed.
Torque
Maximum—both models . . . 15,000 inch-lbs.
Elevator Neck—2⅞" O.D.
Lower Stem Joint—2⅜" API Regular Pin.
Goose Neck—2" API Line Pipe (female thread).

Power Unit
4 cycle gasoline engine, 9.2 h.p. at 2200 RPM, geared 2 to 1 reduction.
Magneto, spark plugs and wiring all spark-proof—exhaust protected with spark arrestor.
Pump equipped with safety valve for 1000 p.s.i. maximum pressure.
Sump Capacity—20 U. S. gallons.

Write for full details
—or see your Baash-Ross Representative

CAMP SANITARY SYSTEMS



This six-inch vitrified clay pipe outfall with four-inch laterals in sand-filter is typical of filter bed construction.

Oil is where you find it — but the chances are good that it will be in a raw and remote region. Although the picturesque era of wild gushers and wilder "boom-towns" has given way to a more prosaic pattern of development, there are still areas on the expanding oil frontier where primitive conditions are a challenge to every step in the discovery, production, and transportation of the nation's crude supply.

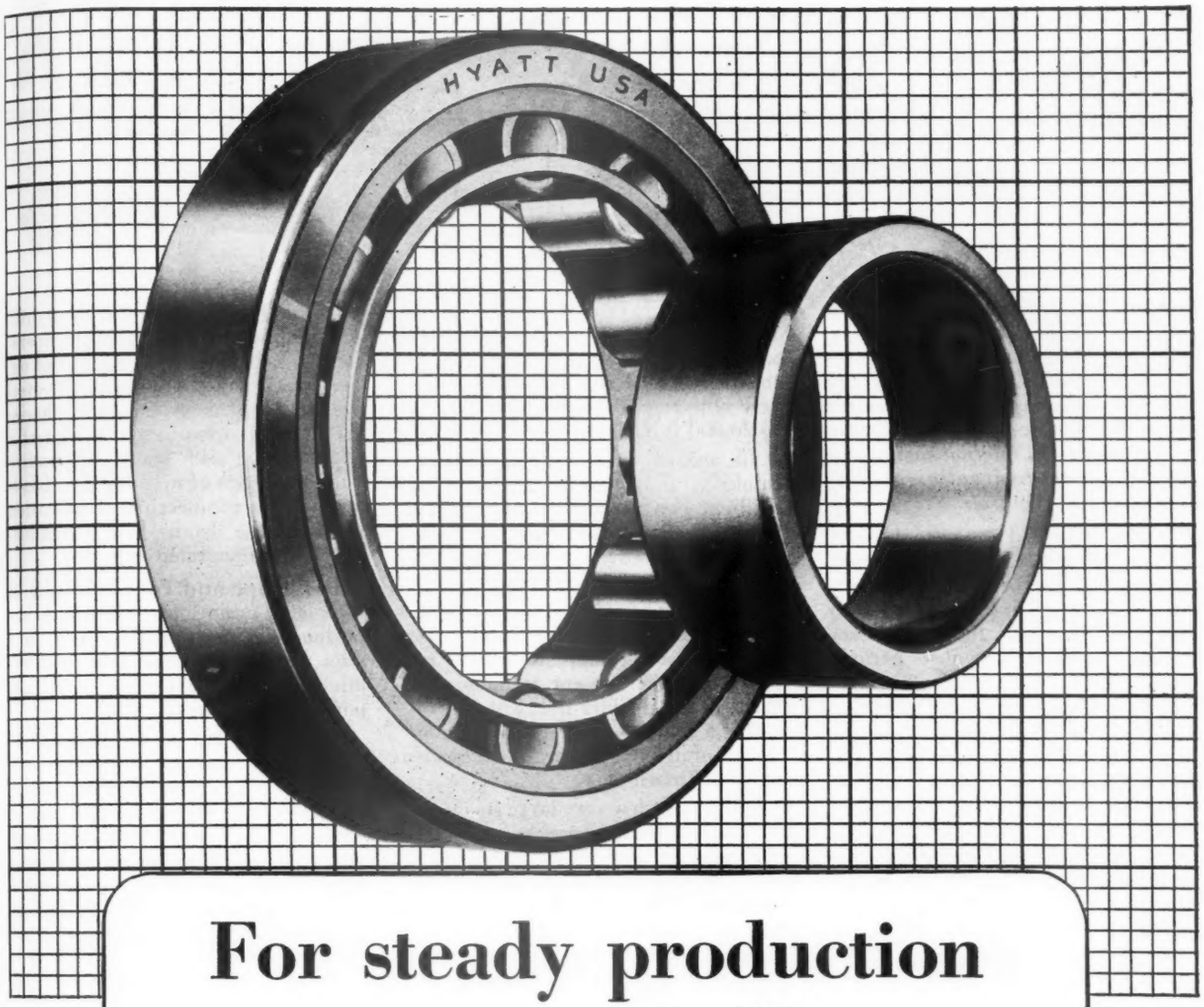
Deep in the brush country on the Mexican border, or high up on the head waters of Bitter Creek, where the mailman gets around once a week in the wintertime, there are access roads to be built, power and communication wires to be strung, camps to be erected for housing the families of drilling crews, roustabouts, warehousemen, supervisory and clerical personnel. On account of their isolation, many of these camps have their own power, water, and ice plants; each of them is served by a sanitary sewer system that, with minor variations, is constructed in a standardized pattern. The importance of this sanitary system is sometimes overlooked.

A four-inch vitrified clay sewer line being laid to cottage.

Since failure of the system would be a serious inconvenience, the design is simple enough to allow a minimum of supervision, and the materials are specified for ruggedness to withstand soil stresses, root penetration, and chemical decomposition. Almost invariably, there will be vitrified clay pipe collection lines from the cottages, emptying into some form of septic tank for primary treatment, whence the effluent is conducted by a vitrified clay pipe outfall to the drain-field or filter bed for secondary treatment. Whenever failures have occurred in these installations the fault has usually been found in the type of secondary treatment provided. In the haste of constructing a new camp, the design engineer has often selected a drain-field layout from some other location without making tests on the absorptive capacity of the soil at the proposed site, with a resulting flooded condition that prevents effective treatment.

Before designing such a system, a few simple field tests will provide sufficient data to indicate the suitability of the soil for drain-field disposal and the amount of filter area required for each person served by the plant.

* * *



For steady production team up with Hyatts

WHEN continuous operation is essential to profitable production, little things such as Hyatt Roller Bearings make an important contribution.

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Team up with Hyatts—specify them for the next equipment you buy. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

DRILLING RIGS FOR DEEP WELLS

J. R. MAHAN*

Abstract. *This paper analyzes the loads encountered and the power required in drilling to 20,000 ft by the rotary method. Discussed are the special engineering problems involved in the design of a rig for such depths, with emphasis on internal-combustion engine power, hydraulic coupling drives, and air controls.*

Introduction. The constant search for new reserves to meet the expanding demand for petroleum products has required drilling to increasingly greater depths, and the term "deep drilling" must be redefined periodically.

Only 20 years ago, in 1928, the record drilling depth was 9000 ft. Ten years later, in 1938, 150 wells had been drilled beyond 10,000 ft and the record stood at 15,002 ft. Now, after another decade, 10,000-ft wells are commonplace; some 400 wells have penetrated beyond 12,000 ft, there are more than 20 below 15,000 ft, and the record stands at 17,823 ft.

*Director of Engineering, The National Supply Company, Toledo, Ohio.

As the oil industry has been able to resume progress since the end of the war, the subject of even deeper drilling has commanded attention, and a new objective of commercial drilling to 20,000 ft has been expressed.[1]

In accord with general postwar thinking, and in anticipating deeper drilling, operators and manufacturers alike have been exploring the possibilities of improved or even radically different methods of drilling.

Revolutionary departures are difficult to predict in the foreseeable future. It seems more logical to assume that the present technological trend in the drilling industry will result in a continued orderly advance in the art of drilling and in the necessary tools and machinery.

Although a few very large steam rig components have been built in the past, enough other essential elements have been missing to prevent the building, until the present time, of an adequate 20,000-ft drilling rig.

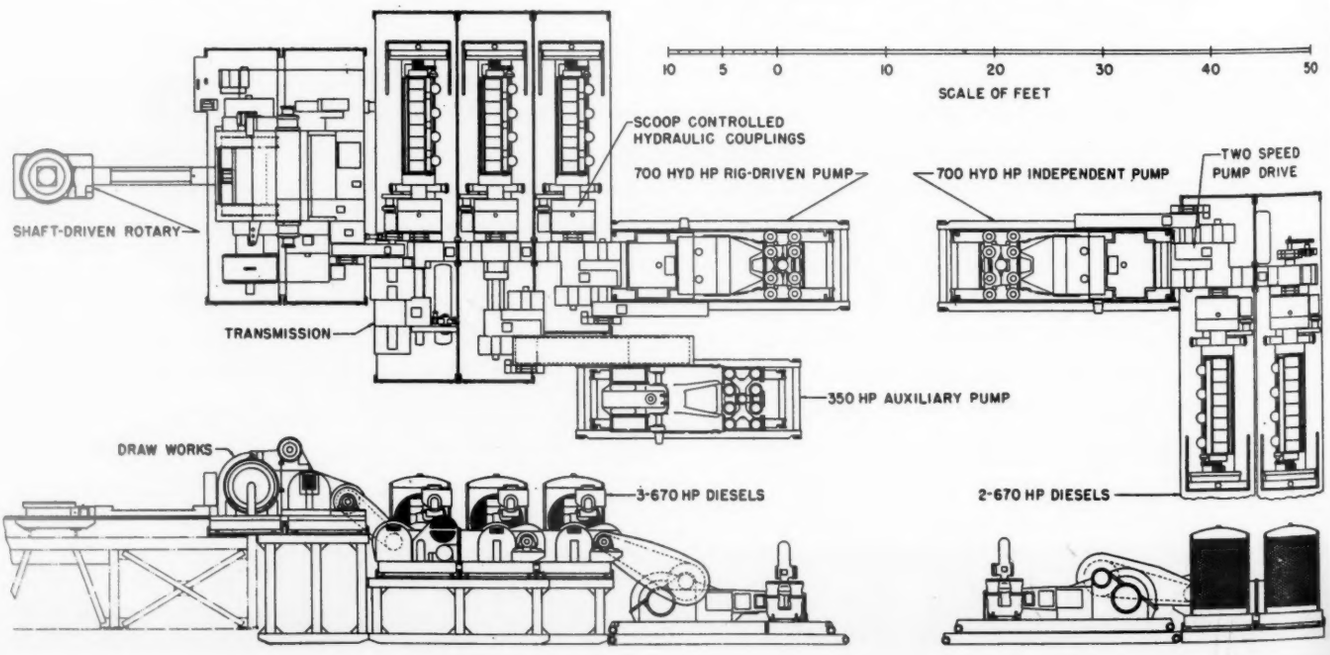
In drilling today's record wells many equipment limitations have been reached. The economics of deep drilling are obviously such that the operator can neither risk the hazard of underdesign nor the burden of overdesign. All of these factors emphasize the need for treating the design of a 20,000-ft rig with broad perspective and knowledge of operating problems and for the engineering coordination of all of the details into a well-balanced and integrated assembly.

Drill Pipe and Tool Joints. Drill pipe and casing are of prime importance in deep drilling and their sizes and weights must first be determined as a basis for rig loads and power requirements.

Drilling to 20,000 ft with security will require stronger drill pipe than the present API grade E with a minimum yield strength of 75,000 psi. As a result of wartime research, small quantities of drill pipe are being manufactured today with a minimum yield strength of 105,000 psi, or 40 per cent greater than grade E.

High strength tool joints, with a minimum yield strength of 165,000

FIG. 1. Layout of a 20,000-ft rig incorporating an independently driven slush pump for large circulation.



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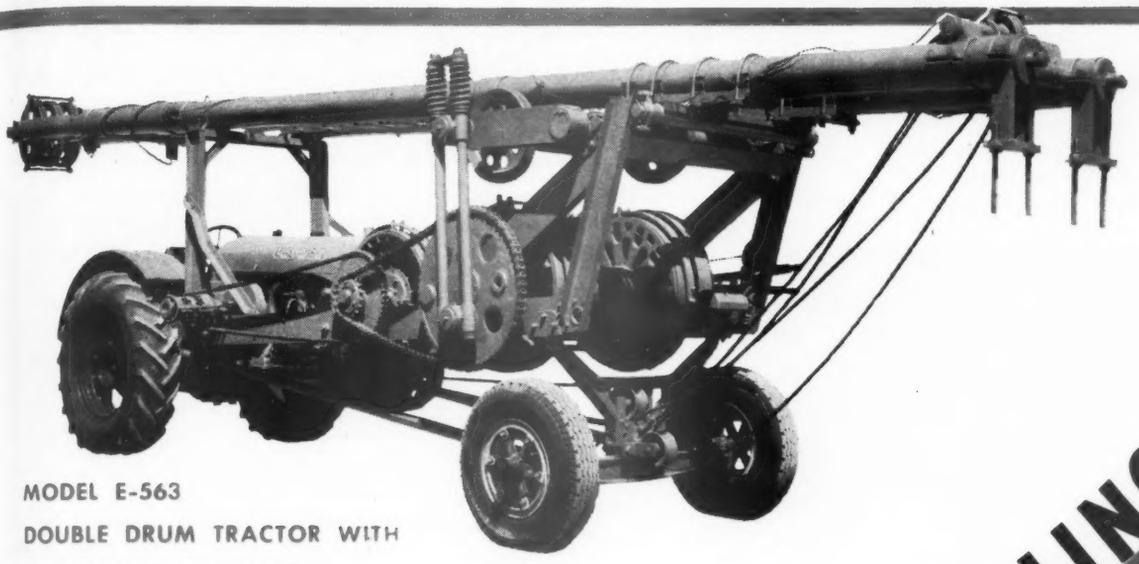

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They are available for burning Butane, Natural Gas, Gasoline or low grade fuels.

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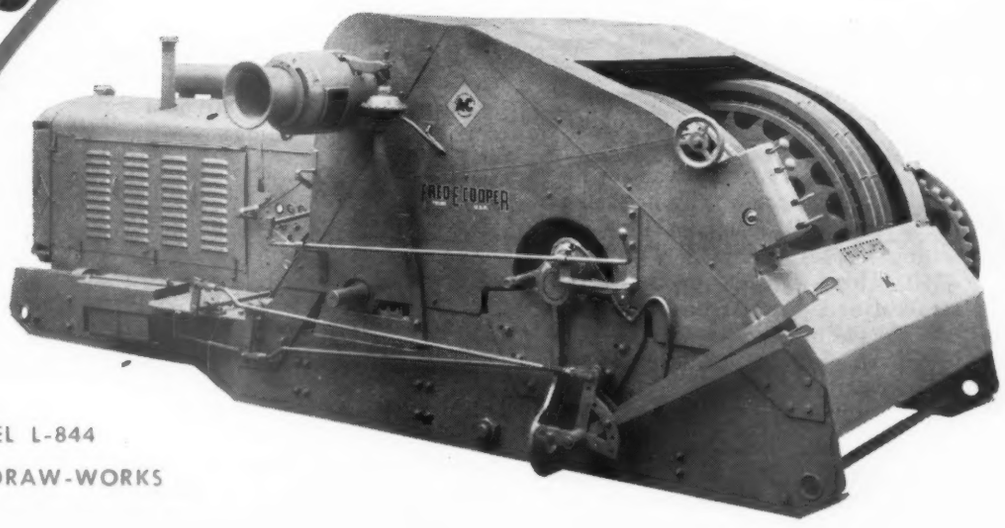

MODEL L-844
52" DRAW-WORKS

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psi, as compared with 115,000 psi for present joints, are also available.

One specification used is SAE 4340, a nickel-chromium-molybdenum steel, is supplied in the normalized-and-drawn state for drill pipe, and in the normalized-quenched-and-drawn form for tool joints.

An improved drill pipe to tool joint connection, in comparison with the API thread, is desirable to develop the full benefit of these physical properties. Several manufacturers have designed shrink thread joints which avoid high stress concentrations, supply a pressure seal, and facilitate replacements in the field.

Baked plastic coatings are proving effective in combatting corrosion and corrosion fatigue.

With emphasis on greater mud circulation, drill pipe must be selected for minimum internal friction and maximum annulus velocity. The new 5-in. OD pipe, internally upset and threaded for API 4½-in. internal flush tool joints, is favorable to large circulating rates.

In 20,000-ft drilling, using high derricks, drill pipe will be racked in 120-ft lengths (or "stands") composed of four joints of range 2, or 130-ft lengths composed of three joints of range 3.

Weights of typical 20,000-ft drill pipe specifications appear in Table 1.

TABLE 1

Ft		Lb
16,000	5-in. OD, 19.5 lb drill pipe complete with tool joints and drill collars....	356,000
20,000	4½-in. OD, 20.0 lb drill pipe complete with tool joints and drill collars....	440,000
20,000	3½-in. OD, 15.5 lb drill pipe complete with tool joints and drill collars....	355,000

▸ **Casing.** SAE 4340 casing with a minimum yield strength of 105,000 psi, as compared with 80,000 psi for API N-80, is also available. A comparison of relative performance properties of these two materials from the standpoint of collapse, bursting, and joint strength is too involved for discussion here. However, Table 2 illustrates the final result in increased setting depths obtained with SAE 4340. These figures are based on streamlined high-strength joints which give needed clearances with heavy weights, in addition to increased setting depths.

Deep wells of the near future probably will use combinations of the above sizes. Multiple intermediate strings or revised programs of the future may require new combinations.

▸ **Drilling Line.** A discussion of the drilling line, from the standpoint of both diameter and reeving, is pertinent at this point as the determination of diameter and of the active spooling length is a prerequisite to hoisting drum design.

TABLE 2. Maximum setting depths SAE 4340 casing

Based on: combination strings, high strength joints, min yield strength 105,000 psi. Min factors of safety: collapse 1.125, tension 1.8, burst 1.1.

Casing OD, in.	9⅝	8⅝	7⅝	7	6⅝	5½	5
Max setting depth, ft	15,000	16,000	20,000	20,000	20,000	20,000	20,000
Wt, lb per ft†	53.5	44	42*	41*	32	23	18
Drift diam, in.†	8.38	7.50	6.42	5.71	5.55	4.55	4.15
Total wt of string, lb	720,000	630,000	765,000	650,000	565,000	375,000	325,000

*New weight.
†Based on heaviest section in combination string.

As the capacity of the present 1¼-in. drilling line has been reached, the use of larger diameters has been questioned, and the employment of more small supporting lines has been considered.

Chonette, in an American Petroleum Institute subcommittee report on deep drilling, reflects the general opinion that conventional numbers of lines, 8 to 10 for drilling, and 10 to 12 for running casing, should be continued.[2]

Several 1⅜-in. lines have been successfuly used within the last two years. A 1½-in. line, now in service about two months, is also giving excellent results, spooling easily on the drum, and running steadily in the 189-ft derrick.

Wire rope 1½-in. diam, with an independent wire rope center, and with a breaking strength of 99 tons, will carry the required loading with acceptable margins of safety, as shown below:

Service	Drill pipe		Casing	
Number of lines	8	10	10	12
Total load, lb	352,000	440,000	635,500	765,000
Load per line	44,000	44,000	63,000	63,500
Factor of safety	4.5	4.5	3.1	3.1

▸ **Derrick.** The American Petroleum Institute has recently established the following tentative standard on a high derrick for deep drilling:

Height	189 ft–0 in.
Water table opening	7 ft–6 in.
Base square	37 ft–6 in.
Derrick capacity	900,000 to 1,500,000 lb
Gin pole capacity	20,000 lb
Rated actual wind velocity	100 mph

▸ **Type of Power.** The power plant has such a direct bearing on the selection of other items of machinery that it will be discussed first.

During the past 15 years, power for drilling has been changed over almost completely from steam to internal-combustion engines. It is interesting to note how closely this has paralleled the trend in railroad motive power.

Originally motivated by the desire for greater portability and for freedom from fuel and water problems, the development of the so-called "power rig" has progressed to the point of universal acceptance. Up to the present time, steam has dominated the field of deep drilling. Here internal-combustion engine power has been handicapped by the lack of large power units, of adequate means for their control, and of large power pump capacity.

Today, engine power units are available in sizes up to 800 hp. Supercharging and other engineering developments have reduced their size and weight. New transmission devices, such as air clutches and hydraulic drives, permit the gathering and control, with even increased facility, of adequate power for 20,000-ft drilling.

Power pumps are available in large sizes and means for operating them in multiple have been perfected.

Within the internal combustion field itself, there is also an interesting trend from gas to diesel engines, in which at least two reasons may be assigned. First, the increasing economic value of gas has swung the balance more in favor of liquid fuel and second, the wartime expansion of the diesel industry to more than 20 times the prewar level has provided a good selection of lighter weight, higher speed engines.

The diesel's value has been enhanced by the perfection of dual-fuel operation. Now, when cheap gas is available, it may substitute for a major portion of the fuel oil, only enough liquid fuel being retained for pilot ignition. Gas is burned at improved efficiency in the diesel cycle. Fuel proportions may be changed while operating.

The general interest in internal-combustion power and its extension to deeper drilling has been a compelling factor in this paper's emphasis on power rigs, rather than steam, for deep drilling.

▸ **Hoisting Loads and Power Required.** Previous paragraphs have indicated, for 20,000-ft drilling, casing loads as great as 765,000 lb and drill pipe loads of 440,000 lb.

The heavier casing loads are encountered only two or three times in the drilling of a well and involve no design problems beyond provision for

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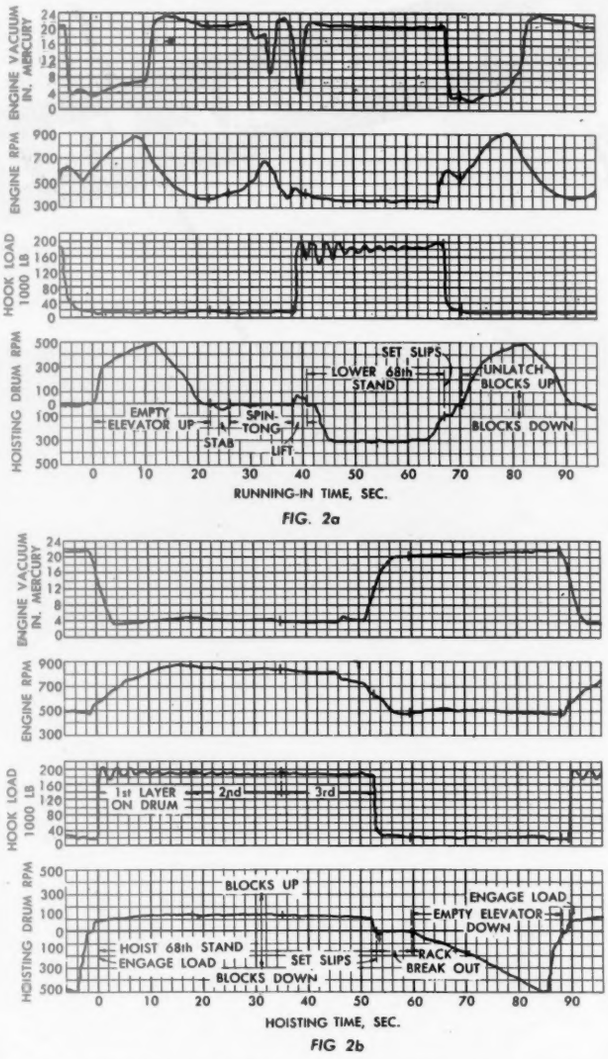


FIG. 2. Strip charts from an actual operation, showing events in (a) the lowering of a 120-ft stand with 8200 ft of drill pipe in the hole and (b) the hoisting of a 120-ft stand with 8200 ft of drill pipe in the hole.

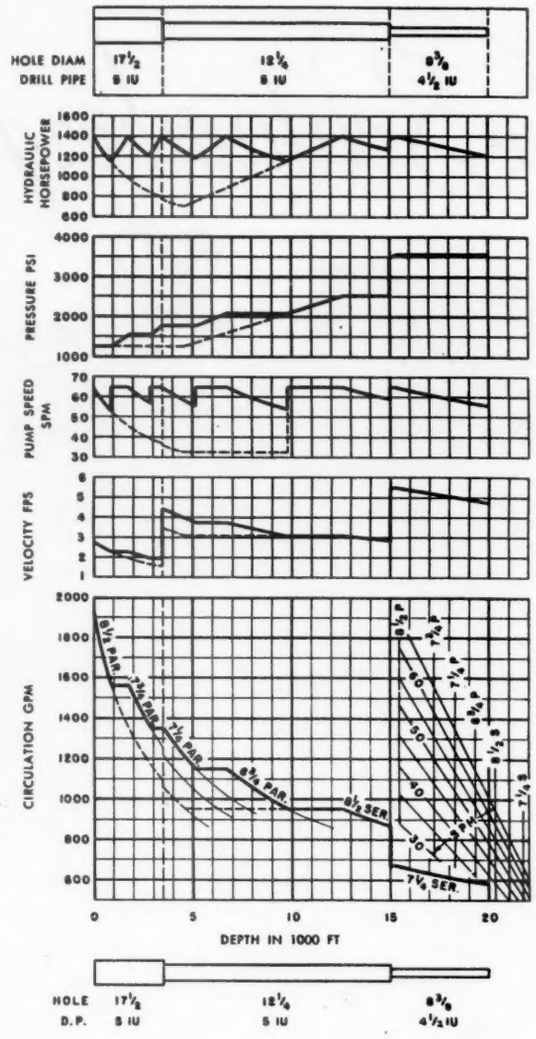


FIG. 3. Curves showing the variation in volumes, annulus velocity, pressures, and power requirement in a typical 20,000-ft drilling program using two 700 hp pumps.

large drum, clutch and brake capacities and for low drum speeds.

The drill pipe furnishes the highly repetitive hoisting load, requiring adequate power and control for efficient rig operation.

Figs. 2a and 2b, taken from strip meter charts of an actual 12,500-ft rig operation, illustrate the events in the lowering and hoisting of a 120-ft stand of pipe. This was the 68th stand in, with 8200 ft of pipe in the hole.

An adequately powered drawworks will start hoisting drill pipe off bottom at rated depth at around 100 fpm, or a 130-ft stand in 78 sec. A conservative figure for over-all efficiency from engines to hook is 65 per cent, with 20 per cent loss through the drawworks and 2 per cent in each hoisting line. On this basis 2050 hp will be required for 440,000 lb of drill pipe. This is equivalent to 1 hp for each 10 ft of 4½-in. drill pipe, a figure which applies equally well at all medium-to-large rigs.

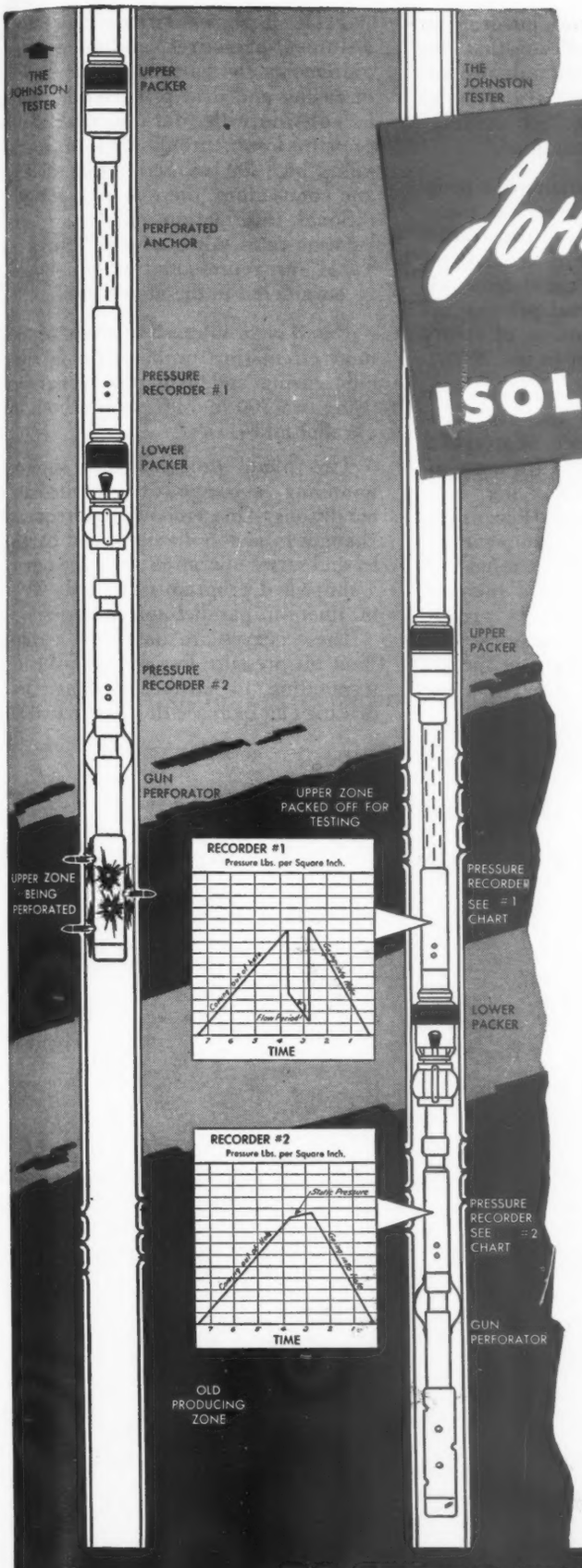
An analysis of the complete round-trip time for a 20,000-ft hole may be interesting. As successive stands are withdrawn, higher drum speeds are used, and the hoisting time per stand is decreased in steps from the 78 sec maximum to 15 or 20 sec minimum which is a limitation imposed by the skill of the crew. About 45 sec per stand additional is required for tonging, spinning-out, setting back, dropping the empty elevator, and latching-on. This gives a total time per stand of 60 to 125 sec. One hundred fifty-three stands of pipe will be pulled in about 4 hr. Pipe can be run into the hole at the rate of approximately 70 sec per stand, or a total time of 3 hr. Total round-trip time, exclusive of that spent out of the hole, will be about 7 hr.

Hoisting power is further increased only on the basis of diminishing returns because so little of the total trip cycle is affected. Other rig operations furnish a more fertile field for increasing the one function which is productive of hole, drilling on bottom.

Rotating Load and Power Required. This is one of the minor power requirements, varying with depth, rotating speed, pipe diameter and hole conditions. In 20,000-ft drilling 500 hp maximum should be required for the normal range of 50 to 500 rpm.

Circulating Loads and Power Required. The circulation of mud is the work-horse job on a rotary rig. More than two-thirds of all horsepower hours are now directed to this function, and there is a well-defined trend toward even greater pump loads.

This energy is expended both in maintaining circulation down the



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CHICHASHA, OKLAHOMA

drill pipe and up the annular space, and in creating nozzle velocity or jetting action at the bit.

In a recent paper, Crake emphasized the value of high circulating rates and stated that rate of flow determines the following:[3]

1. The rate at which cuttings are lifted to the surface.

2. The volume of cuttings carried by each cubic foot of mud and, therefore, mud contamination.

3. The speed at which mud in the hole can be reconditioned, or the weight or other characteristics changed, to suit emergencies, or other conditions.

4. The size of the cavings which can be removed, and, thus, the hazard of sticking pipe.

5. The amount of gas entrained in a cubic foot of return fluid and, thus, the blowout tendency of the fluid column.

6. The amount of "bad mud" contained in the well in case of a blowout hazard.

Nolley, Cannon, and Ragland, in a recent significant report on drag bit drilling research, indicate that the rate of penetration is not only proportional to circulation, but also drag-bit nozzle velocity. This "jet drilling" created additional pump load.[4]

Brantley, in summarizing the progress of drilling techniques, as measured by increased rates of penetration in both soft and hard formations, states, "It seeems that the statement is still true that in general practice the maximum efficient volume of rotary drilling fluid is not yet in use."[5]

Currently, upward circulation in the annulus, between the drill pipe and the walls of the hole, is around 2 to 3 fps. Rates of 3 to 4 fps are considered more desirable, and even higher rates are discussed (lower rates are used in drilling caving surface hole). It should be borne in mind that these rates are based on a nominal hole diameter which may be greatly exceeded in certain formations with a corresponding reduction in the actual circulating rate through these portions of the hole.

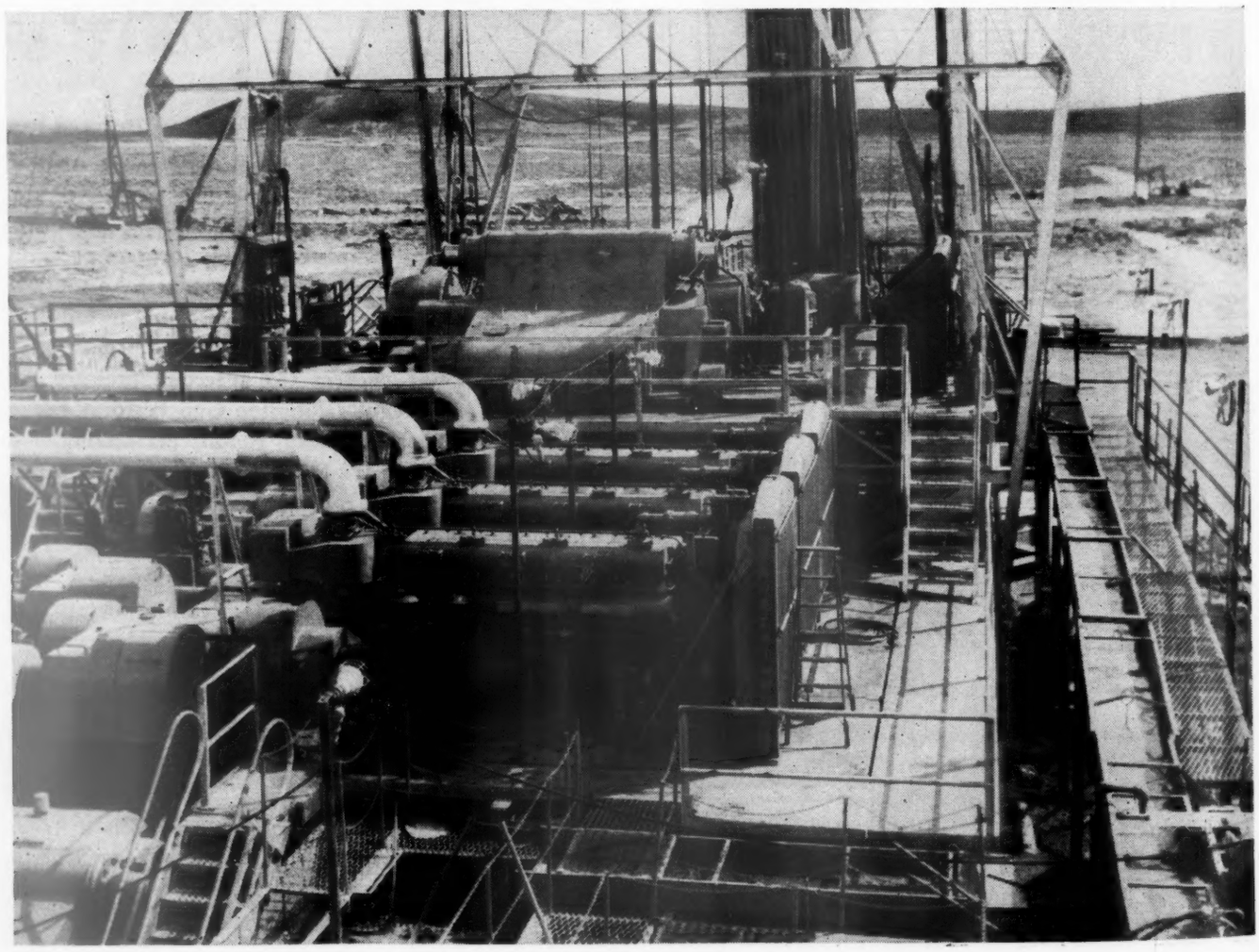
Table 3 shows circulating rates, volumes, pressures, and power requirements for various combinations of casing and drill pipe. While there is considerable data available on pressure losses through drill pipe, annulus, bit (200 psi used in this table), and connections, there is need for additional information on larger circulation rates. Although the figures in Table 3 are representative, they should be considered in the above light.

Fig. 3 is an interesting study of the mud circulating problem for a specific casing and drill pipe program, using two 700 hyd hp pumps, both in parallel and series.

Two pump programs are shown, bounding a range of intermediate conditions: One embodying frequent changes in piston diameter and parallel and series operation; and the other a simplified program using only 8½-in. liners in parallel and in series.

These curves are based on a constant bit pressure loss of 200 psi corresponding to normal drilling. Jet drilling can increase this figure to 800

FIG. 4. A 2010-hp rig drive group using three supercharged dual fuel diesel engines.



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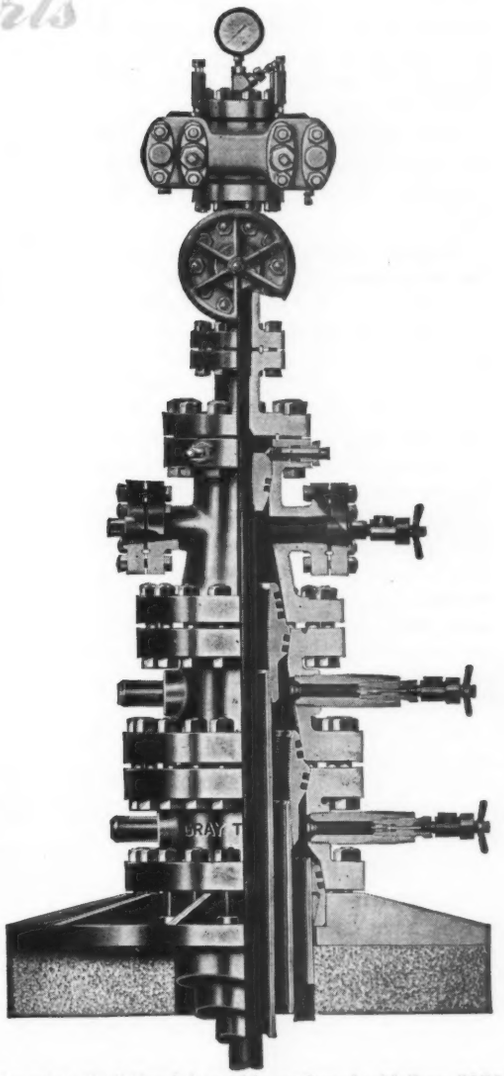

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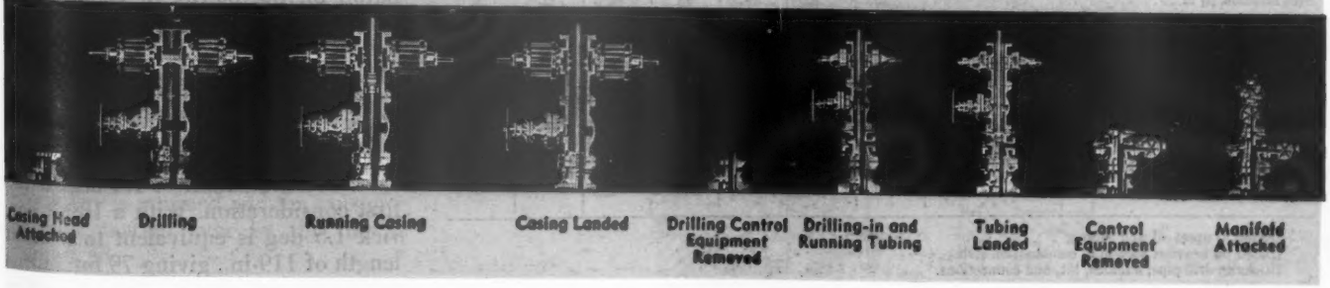
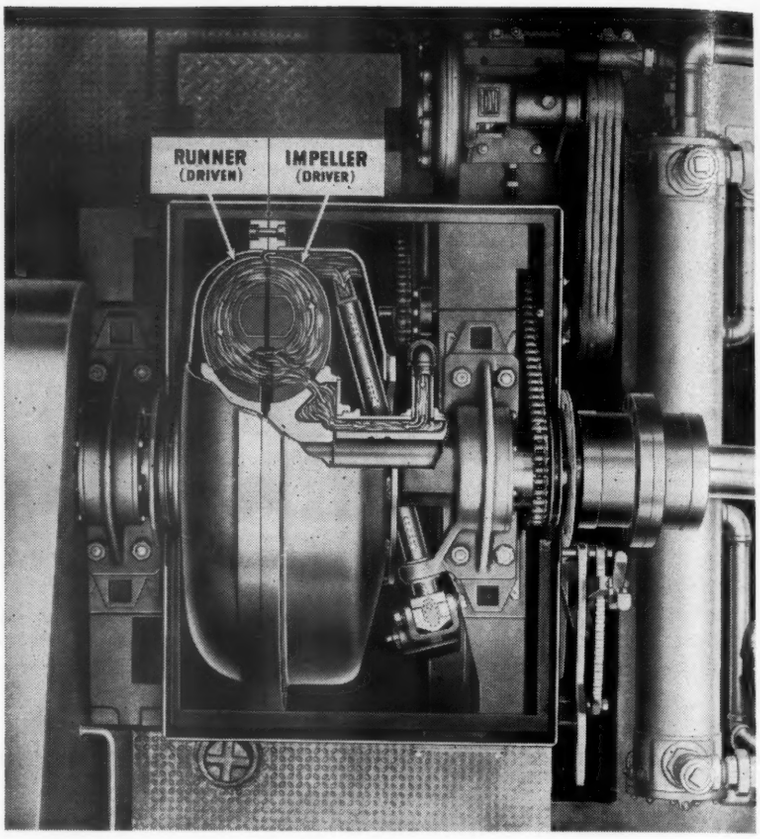


FIG. 5. Compact built-in type hydraulic coupling with sliding scoop control.



psi or more. This will result in even greater pump loads. For example, at 3 fps in a 12¼-in. hole, 600 psi increase in pressure results in 335-hp additional pump load.

Mud circulation for 20,000-ft drilling may easily require 1400 hyd hp, normally equivalent to 1650 bhp input.

Engine Drive Group. Hoisting has been shown to require about 2050 hp, rotating a maximum of 500 hp, and circulating approximately 1650 hp.

During the making of a round trip to bring the pipe and bit out of the hole, all of the engine capacity will be applied intermittently in hoisting. During the drilling cycle the power will be applied to the pumps and the rotary in the ratio of 3 or 4 to 1. The power plant is, therefore, conveniently divided into three or four units tied together with the necessary compounding drives and supplied with clutches for flexible operation. Fig. 4 shows such a drive group.

Excess engine capacity is often provided to give either reserve power or extra power for the pumps. In the case of unusual circulating loads, an independently driven pump and additional engines may be provided.

Hydraulic Drives. Hydraulic drives have been advantageously applied to drilling rigs both in the form of hydraulic couplings and of torque converters. Torque converters have been used most generally on small hoists, and the hydraulic couplings have predominated in the large rig field.

Hydraulic couplings, used in industrial, marine, and automotive applications for some time, were first recognized by the drilling industry over a decade ago as a safeguard to rigs operated by native labor in foreign fields. Rig applications have mounted to the point where a large portion of big rigs are so equipped.

The hydraulic coupling, driving through a vortex of oil, isolates the engine from the viewpoint of torsional vibration, and blocks the transmission of excessive shock loading in either direction, permitting the transmission of more useful loading.

The scoop regulates the amount of fluid in the operating circuit and thus controls the slip through the coupling while maintaining a 1:1 torque ratio. The drive may be softened for sensitive operation; or the machinery operated at very slow speeds or against stalled loads. The fluid may be entirely evacuated from the coupling as an engine cut-off device.

The scoop-controlled coupling also assists in the control of multiple pump operation.

Recently a new type sliding scoop coupling has been built into the engine extension shaft, giving a simple and compact arrangement as compared with the mounting of stock couplings. See Fig. 5.

Draw Works. Only the draw works elements requiring particular treatment from the standpoint of large rig design will be mentioned here.

Main Drum. There has been speculation on the merits of spooling the active line in a single layer on a large drum in accordance with mine hoist practice as compared with the conventional multiple-layer winding. An analysis of this may be interesting.

Fleet angle, which is usually limited to a very maximum of 1.5 deg, is the first consideration. With a 189-ft derrick 1.5 deg is equivalent to a drum length of 119-in., giving 79 total turns of 1½-in. rope, or a net of 70 active

TABLE 3. Mud Circulation

Volumes, pressures, and power required for typical combinations of casing drill pipe at various velocities in annulus.

Casing OD, in.	20	13⅜	13⅜	13⅜	9⅝	9⅝	7	5½	5
Setting depth, ft	1,800	3,500	3,500	3,500	15,000	15,000	20,000	20,000	20,000
Drill through to, ft	3,500	15,000	15,000	15,000	20,000	20,000	20,000	20,000	20,000
Wt, lb per ft†	94	68	68	68	53.5	53.5	41	23	18
Drift diam, in.†	18.94	12.26	12.26	12.26	8.38	8.38	5.72	4.55	4.15
Bit diam, in.	17½	12¼	12¼	12¼	8⅜	8⅜	5⅝	4½	4⅛
Drill pipe OD, in.	5	5	4½	4½	4½	3½	3½	2⅜*	2⅜*
Drill pipe upset	int	int	ext	int	int	ext	ext	ext	ext
Area hole, sq in.	241	118	118	118	55.1	55.1	24.9	15.9	13.4
Area drill pipe OD, sq in.	20	20	16	16	15.9	9.6	9.6	4.4	4.4
Area annulus, sq in.	221	98	102	102	39.2	45.5	15.3	11.5	9.0
Circulation for 2 fps, gpm	1,380	610	635	635	245	285	95	72	56
Total pressure drop, psi‡	1,750	1,520	2,420	3,170	1,040	3,750	810	..	..
Power required, hyd hp	1,400	540	900	1,170	150	620	45	..	..
Circulation for 3 fps, gpm	2,070	915	955	955	365	425	140	110	85
Total pressure drop, psi‡	3,200	2,740	4,460	5,890	1,740	6,950	1,325	..	..
Power required, hyd hp	3,850	1,460	2,500	3,300	370	1,730	110	..	..
Circulation for 4 fps, gpm	2,760	1,220	1,270	1,270	490	570	190	145	115
Total pressure drop, psi‡	..	4,240	6,970	9,250	2,760	10,950	2,050	..	..
Power required, hyd hp	..	3,000	5,150	6,900	790	3,650	225	..	..

*External upset oil well tubing.
†Based on heaviest section in combination string.
‡Includes drill pipe, annulus, bit, and connections.

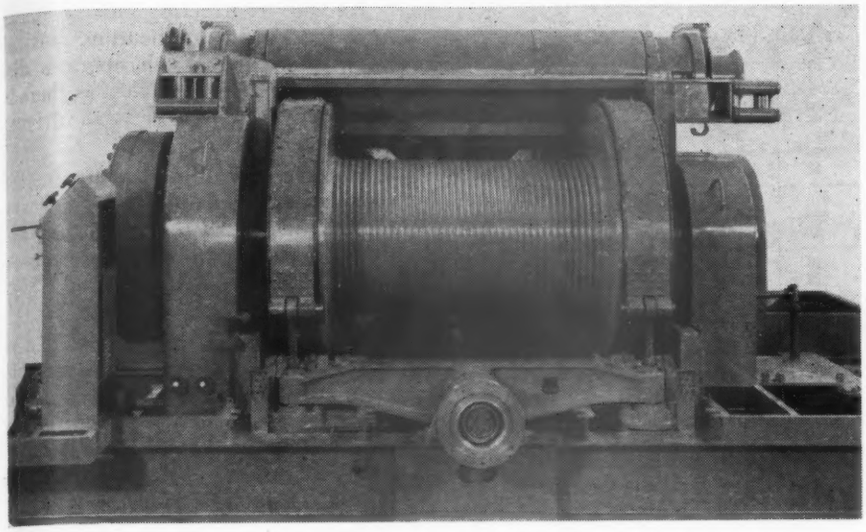


FIG. 6. A large drum shaft assembly with band brakes.

turns after deducting the usual 9 anchor wraps. Eight-line reeving with 135-ft hook travel, requires the spooling of 1080 ft of active line, or 15.4 ft per turn.

This necessitates a drum diameter of 58 in. With this large drum, conventionally designed friction brakes would grow to 100 in. diam. With the slower drum speed, drum shaft torque would increase, requiring larger absorption brakes and heavier chain drives. Such a design would involve additional weight and expense and the dimensions could not be held within highway limits.

The requirements for an economical and portable design seem paramount. Furthermore, as compared with stationary industrial application, the very nature of drilling service seems to contribute an element of expendibility to the drilling line which minimizes the value of these theoretical considerations.

Wire line abuse on a drilling rig can be reduced to a practical minimum by: confining the winding layers to the first three on the drum, using a grooved drum with properly designed filler and riser strips, using a minimum fleet angle, and periodically shifting the wire line on the drum and tackle by cutting a short piece from the drum end.

Sand Reel. This reel, with spooling capacity for 20,000 ft or more of $\frac{5}{8}$-in. line, is considered by many operators to be more acceptable as an independent unit than as a built-in part of the draw works. Greater accessibility is attained and the nuisance of mud carried over by the line is minimized.

Drum Friction Brakes. Many designers have sought a new brake construction which might have some advantage over the conventional band type.

Such a development may be made, but in the meantime, it is well to remember that the draw works is a natural application for the band brake and that for this reason it has been better engineered than most other industrial brakes of this type.

On the draw works its servo-action enables the stopping and holding of enormous loads with little more force than is supplied by the weight of the brake lever. When the drum must reverse upon the engagement of a clutch, the band brake evidences an automatic ratchet-like releasing action, requiring no timed release. Compared with a multiple disc brake, for example, the band type is very adaptable to a free-rolling drum for dropping the empty blocks.

While many industrial brakes need a high energy absorption capacity per cycle, few brakes require such absorption capacity per hour as the draw works brake; and for this reason the ease of water-cooling the band brake is advantageous.

The use of the highly engineered band brake may be continued logically to the 20,000-ft rig. Such a brake is shown in Fig. 6.

Air Brakes. Air actuated brakes, although used experimentally on draw works for at least 10 years have gained acceptance slowly due to the general satisfaction with manual brakes and the requirement for a high degree of reliability. This development is now receiving some impetus from the broader use of air on rigs

FIG. 7. Diaphragm-operated multiple-disc air clutch, rated 2,560,000 in.-lb at slipping, for drum shaft application.

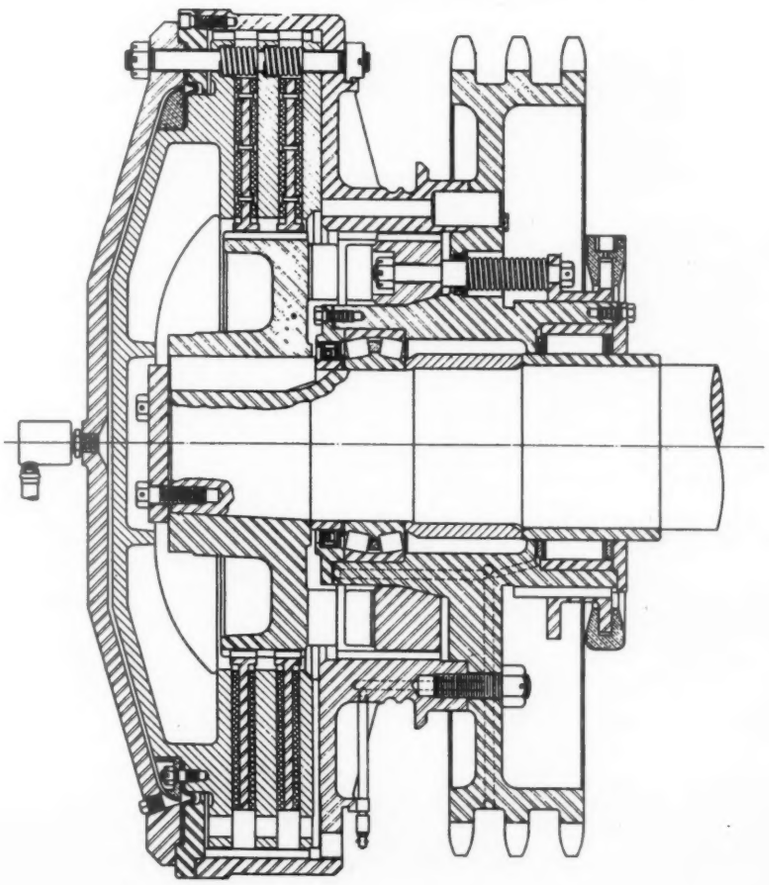


TABLE 4. Standby characteristics of multiple pump operation

	Pump combination	Piston diam	Pump, rpm	Volume, total	Volume, 1 pump	Pressure, total	Pressure, 1 pump	Hyd hp total
1	Two in parallel	6¼	65	970	485	2500	2500	1400
2	One of parallel	6¼	65	485	485	825	825	235
3	Line 2 in per cent line 1	..	100	50	100	33	33	17
4	Two in series	8½	65	970	970	2500	1250	1400
5	One of series	8½	42	630	630	1250	1250	460
6	Line 5 in per cent line 4	..	65	65	65	50	100	33
7	One of series, 125 per cent load	8½	48	720	720	1560	1560	670
8	Line 7 in per cent line 4	..	74	74	74	63	125	48
9	One of series, 150 per cent load	8½	54	810	810	1875	1875	890
10	Line 9 in per cent line 4	..	83	83	83	75	150	64

Assumptions: Pressure varies as 1.6 power of ratio of volumes; hp varies as 2.6 power of ratio of volumes.

and from some requirements for remote brake operation. Air brakes are just reaching the commercially practical level.

Transmission. Large draw works transmissions may be more-or-less conventional although there is a trend toward higher speeds in the interest of weight reduction. Chain drives present no particular problem due to the tremendous advances in the building and application of roller chains. Transmission chains are operated satisfactorily to speeds of 4000 fpm. Draw works load cycles may be predicted and chain fatigue life estimated.

A typical 20,000-ft draw works design uses API 3⅛ triple chain for the drum drives, ASA 2-in. quadruple for the jackshaft drives, and ASA 1¾-in. quadruple for the transmission and engine compound drives.

Clutches. Air clutches are used almost exclusively for the frequently-engaged rig drives.

Radially-contracting air clutches have found wide application, particularly where the clutch operates disengaged for long intervals, as there is no moving contact between driving and driven elements.

However, multiple-plate air clutches seem better adapted to the very heavy torque loading of drumshaft applications on account of their compactness. A 42-in. plate clutch, rated at 2,560,000 in.-lb, is shown in Fig. 7.

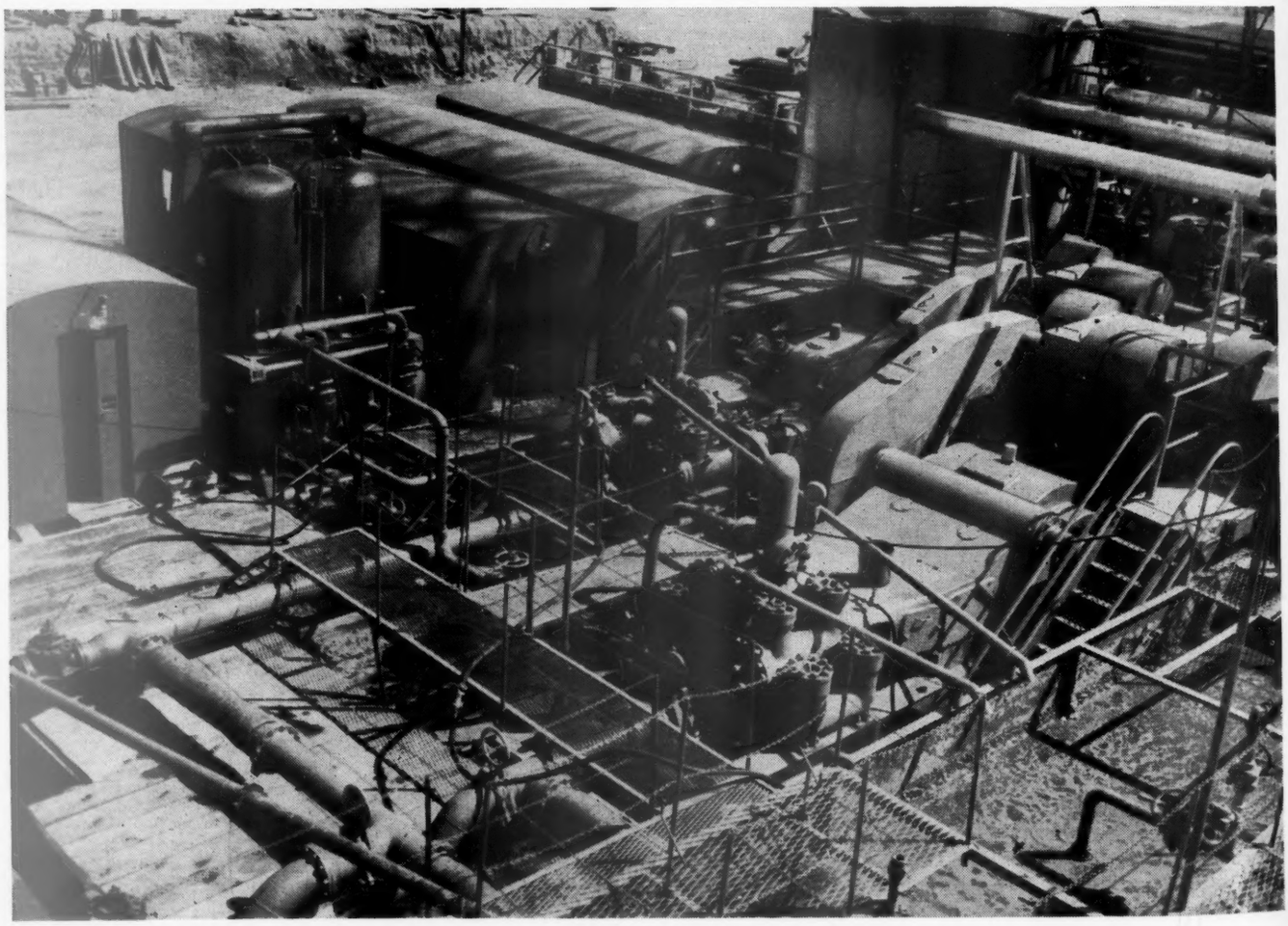
Controls. Well designed and adequate controls are the key to the efficient operation of large rigs. Air controls are widely applied, being used for engine throttles, clutches, hydraulic coupling scoops and other miscellaneous operations.

Drill pipe feed-off devices are of increasing importance on large rigs and these are available in several types.

▸ **Power Slush Pumps.** At least two large power pumps are now available, with capacities of 639 and 700 hydraulic hp.

Reasonably effective fluid circulation with a normal hole program to 20,000 ft requires the combined

FIG. 8. The 700-hp and 350-hp rig driven pumps of Fig. 1 with air chambers for series operation.



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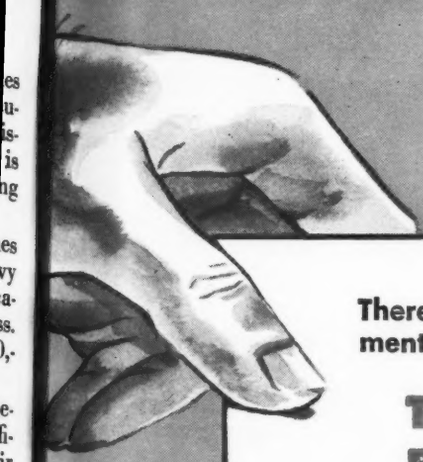

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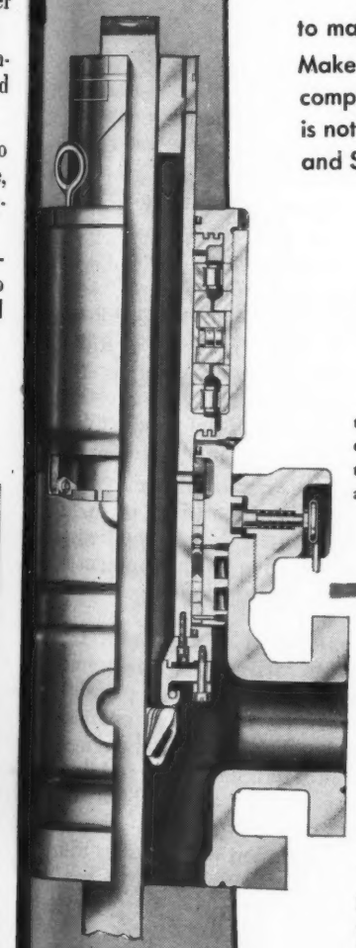

the compactness and city of the Shaffer Com- ion Rotating Blow-Out nter and Stripper. Also its built-in circulation tions that further save and simplify hook-ups.

It provides continuous seal!

Because the Shaffer Combination Rotating Blow-Out Preventer and Stripper maintains its leak-proof seal *continuously* while pipe is in the hole, there is nothing to *operate,* nothing to *remember,* nothing to *forget* when sudden pressure emergencies occur. The unit is *always* packed-off around the drill string . . . *always* ready for instant protection against pressure blow-outs!

It seals around any shape!

In addition to maintaining a continuous pressure-tight seal, the stripper rubber in the Shaffer Combination Rotating Blow-Out Preventer and Stripper also expands and contracts *automatically* to fit the various shapes and diameters in the drill string. It seals around square, hexagon and octagon kellys as well as around drill pipe. And, excepting such abnormally large diameters as bits and reamers, the varying diameters of the tool joints, upsets, couplings, substitutes, etc., readily strip through the unit without losing the pressure-tight seal!

Maintenance is negligible!

Because the Stripper Unit and kelly rotate together—not one inside the other—wear on the Stripper Rubber is reduced to a minimum. Moreover, there is no flexing of the Stripper Rubber or loss of sealing contact around the kelly or drill pipe as the drill string rotates, thus-assuring a continuous and tight seal.

In addition, the bearing assembly upon which the unit rotates is specially engineered to withstand the severe loads of modern high speed drilling, with separate thrust and radial bearings to carry each type of load. Bearings are lifetime pre-packed with heat-resisting lubricant, further minimizing maintenance!

No Special equipment required!

In addition to its many other advantages, the Shaffer Combination Rotating Blow-Out Preventer and Stripper requires no special kellys or drill strings for its operation. The unit seals off around *any* type of pipe—coupled, upset or flush—with equal efficiency and safety whether the drill string is being raised or lowered, rotated or not. Also, a square, hexagon or octagon kelly may be used—whichever is preferred—and the unit seals automatically and continuously around each type.

What's more, such abnormally large diameters as bits and reamers can be readily passed through the unit by simply pulling a latch and rotating the Bonnet 1/6th turn, whereupon the entire internal mechanism is withdrawn with the bit or reamer. Simply reverse the operation when going back into the hole. It's easy, *quick!*

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capacity of at least two of either size. At the present time the building of the required capacity and reliability into a single portable pump seems impracticable. Multiple operation is required and following paragraphs will show that this is not only feasible but also advantageous.

Multiple Pump Operation. Steam pumps have long been operated in parallel and in series to great advantage. Pumps are paralleled for the large volume required at low pressure for top-hole drilling, and connected in series for the smaller volume required at high pressures in the small hole. This is illustrated in Fig. 3.

In parallel, the displacement is divided between pumps and each carries the total pressure load on its pistons and valves.

In series, each pump handles the full displacement, the low pressure pump taking fluid from the suction tank and discharging it into the suction of the high pressure pump, which in turn boosts the pressure to full manifold value.

Experience has indicated improved valve and piston service in series-connected pumps. The construction of the mud piston is such that the advancing lip apparently carries only the net pressure differential. Large pistons normally used in series work are also inherently better than extremely small pistons, in addition to having less area difference between the head end and rod end.

Unfortunately, these advantages have not accrued to operators of power pumps. Over the years, many have tried unsuccessfully to operate power pumps in series. A few have carried the operation almost to the threshold of accepted practice. Even as late as 1948, writers have pronounced series operation impractical.

Faced with this bottleneck in the design of the largest power rigs, one concern recently undertook a cooperative research program, which resulted in carrying series pumping the one last step to acceptable practice.[6] This solution was accomplished with large air chambers supplemented by hydraulic coupling drives.

It is interesting to study the problem of emergency standby capacity with this type of operation, assuming only the two pumps are available and no piston changes can be made. Multiple operation at full speed is assumed.

With either series or parallel operation some circulation is available, which does not obtain with a single large pump.

When one of a pair of paralleled pumps is stopped, the remaining pump continues at full speed under partial load, the displacement falls to 50 per cent, the pressure to 33 per cent and the power requirement to 17 per cent. This and the following example will be clarified by examining Table 4.

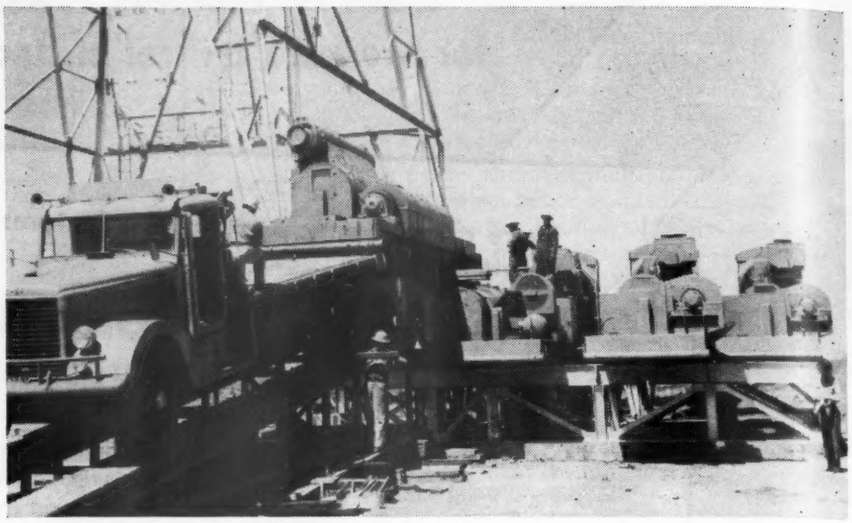

FIG. 9. Installing the back half of the drawworks on a 20,000-ft rig, showing the degree of portability retained.

In series, the remaining pump tends to assume full load which is immediately compensated by a decrease in engine speed. The speed may be adjusted manually to produce any desired pump loading, assuming sufficient engine capacity is available. The single pump may be operated at full torque (rated pressure for a given piston diameter) by adjusting the speed and displacement to 65 per cent, producing 50 per cent pressure and requiring 33 per cent power. If an emergency dictates, even greater circulation may be obtained by speeding-up, and overloading, the pump.

The use of large air chambers and hydraulic coupling drives has so simplified and improved series functioning that a more even flow and steadier discharge pressure obtains than has been experienced with single pumps. Load distribution between pumps is easy to maintain.

Fig. 8 shows a large pump installation with air chambers arranged for compounding.

Two-Speed Pump Drives. Usually a single-speed pump drive is a compromise between the high volume requirement of top-hole drilling and the reduced capacity needed for small holes and small drill pipe.

With two speeds, the fast drive may be selected to run the pump at top rated speed with the engine running at its maximum rpm. The low-drive is usually selected for half speed.

Such an arrangement can be used to overload the pump, which is often justified in an emergency.

However, where only small volumes are required, not obtainable with minimum pistons, the low speed drive will actually avoid a pump overload and permit running the engine at a reasonable speed.

Low speed operation, with no torque multiplication, can be obtained with the hydraulic coupling. However, if the operation is to be continued for more than a few hours, a low speed drive is advantageous from the standpoint of fuel economy.

Conclusions. The design of rigs for 20,000-ft drilling, with normal margins of safety, is entirely practicable. They can be reasonably compact and portable. Dual-fuel diesel engines, with their inherent economy and flexibility of fuel supply, are probably the preferred power. Improved controls enable the operation of such rigs with even new facility.

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* * *

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With heads that require installing the slips and packoff after the preventer is picked up, ***blowouts can occur*** from a gas sand above the cement and below the surface pipe.

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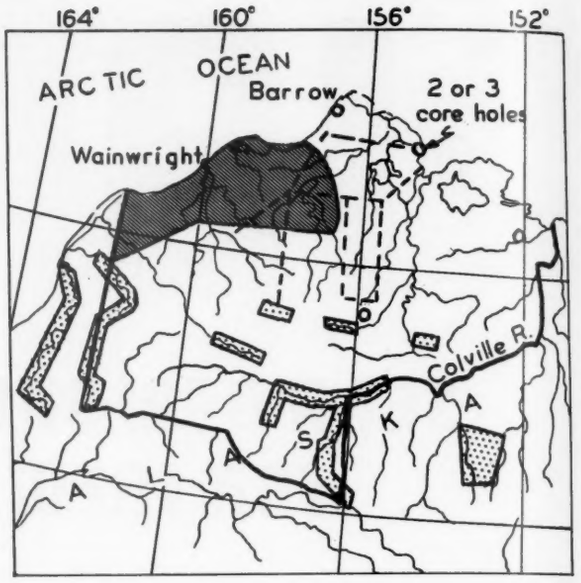
READY TO COMPLETE WELL SAFELY —The "T-16-1" Tubing Head has been slipped over the top of the casing, the flange made up and I-seal screws tightened, providing a means of using the test port to test the seal between the I-bottom and the "C-19" Casing Hanger. 7" hydraulic operated drilling master gate has been installed. With blowout preventers attached above the master gate, the well is ready to perforate or drill out cement and complete the well.

1949 Program for Oil Exploration in Alaska



TWICE each year in the Spring and Fall, the operating committee established by the Secretary of the Navy meets to advise him concerning policies and plans in connection with the Navy's exploration for oil in Naval Petroleum Reserve No. 4 (Alaska). The fall meeting of 1948 was held in the Navy Department, Washington, D. C., on 15-16-17 November.

After final review and discussion of the information presented, the committee reached the following conclusions regarding the formulation of the exploration program in Naval Petroleum Reserve No. 4 for the calendar year 1949 for the purpose of determining the oil possibilities within significant basin features indicated by previous work.

These features are:

(a) An ancient mountain in the Point Barrow area now covered by approximately 2500 ft of marine sediments known to contain some oil-bearing sand. Two Barrow wells and two seismograph parties will develop this feature.

(b) An ancient ridge, running southeast from Barrow to Umiat, which appears to divide the Arctic plain into two separate sedimentary basins. One seismograph party will develop this feature.

(c) An eastern Tertiary basin containing live oil seepages, one located over an indicated seismograph anticlinal flexure and another over a pronounced gravity anomaly. One well and one group of core holes will test two prominent seepage areas.

(d) A western Cretaceous basin within which distinct possibilities exist for favorable oil-bearing structure and stratigraphy. One test well, one gravity meter survey, and a partial season's work by one seismograph party will test and develop this feature.

An important aspect of the 1949 program is the provision for six field geological parties to detail structure for drilling sites and to study thickness and facies of lower sediments in outcrop with a view to estimating character and depth of these sediments within the two basins.

Based on these conclusions, the Committee recommended the following program to continue the exploration through the calendar year 1949.

Survey Program.

1. Weasel party work Kiruktagiak and lower beds between Okmilaga and Chandler Rivers from 68° 45′ N. to 68° 15′ N.

2. Weasel party work Ikpikpuk Anticline tying into Maybe Creek Dome and Wolf Creek Anticline, then move west and work Upper Titaluk Anticline. Objective—drilling locations.

3. Weasel party work Upper Meade River Anticline then move south and work as much of Carbon Creek Anticline as possible. Objective—drilling locations.

4. Boat party work Colville River from Kurupa River to Kuna River, thence up Etivluk and Kuna Rivers to headwaters. Objective—stratigraphy of Kiruktagiak and older rocks.

5. Boat party work Kokolik River and Kukpowruk River from mouth to headwaters. Objective—stratigraphy and structure with particular emphasis on Kiruktagiak and lower rocks.

6. Airborne party to work selected localities of Lisburne limestone and other rocks.

Arctic Contractors Program.

(A) *Drilling.*

1. Rig up Wilson Supertitan on Oumalik anticline for a 15,000-ft test, drill to 5-6000 ft by November 1949, then make decision whether to (a) continue to drill ahead; (b) case well and suspend for future decision; or (c) abandon well.

2. Drill at location just east of Fish Creek oil seep with National 50 Rig, to depth of 6000 ft or less.

3. Drill two or three core holes to 1200 ft or less at Simpson oil seeps, using Failing Rig.

4. Drill South Barrow No. 2 at location approximately 5 miles southeast of Barrow Camp using the Cardwell Rig, to approximately 2500 ft, commencing as soon as possible.

5. Drill South Barrow No. 3, if possible, at location 3-5 miles south of South Barrow No. 2.

(B) *Geophysics.*

1. Gravity meter.

(a) Using one flying gravity crew, cover area from Skull Cliff south to junction 157°W — 70° 15′N, thence west to junction 160°W—70° 15′N, thence south 45°W to junction Reserve boundary and 69° 45′N, thence north along boundary of Reserve to Arctic Ocean, thence northeast along shore of Arctic Ocean to Skull Cliff.

2. Seismograph.

(a) Party A—Area Smith Bay—Oumalik—north along Topagoruk River to 70° 30′N, west to coal mine.

(b) Party B—Gas seep on Upper Meade River Anticline north to coal mine, thence southwest along Nigiaktuvik River.

(c) Party C—Detail West Barrow area, tie in with refraction lines No. 10 and No. 11, and then tie in to coal mine.

(d) Party D—Detail East Barrow area to Dease Inlet and tie across to Cape Simpson seismograph net.

(C) *Procurement of Supplies.*

The Committee recommended that the Contractors provide supplies for the calendar year 1950 based on a program similar to that outlined above for the calendar year 1949. These supplies should include the procurement and rehabilitation of the National 125 drilling rig now available in Naval Petroleum Reserve No. 1 (Elk Hills, California). This rig is Navy property and can be obtained at no cost. * * *

minimize reservoir oil SHRINKAGE through RESERVOIR FLUID ANALYSIS

As one barrel of reservoir oil is brought to the surface and its gas comes out of solution, that barrel of oil *shrinks to less* than a barrel of stock tank oil. This shrinkage, directly related to the amount of gas allowed to evolve from the oil, often runs as high as 60 percent. Thus, the benefits to be gained by correcting current field operating practices in order to hold this shrinkage of reservoir oil *to a minimum* are of definite economical significance.

An accurate laboratory measurement of the *flash* gas-oil ratio, made at various separator pressures, will reveal the amount of shrinkage occurring under specific field conditions. Then, with these data, an operator can determine the optimum separator pressure to obtain more oil at the surface per barrel of oil removed from the reservoir. (Gravity of the oil being produced can be raised through use of the same data.)

Core Lab's service of Reservoir Fluid Analysis is designed solely for the purpose of obtaining and analyzing bottom hole samples from key wells to determine whether or not you are operating your reservoir under optimum conditions.

Shrinkage and gravity are only two of the many physical properties which are developed from a measurement of Pressure-Volume-Temperature relationships of the oil and its dissolved gas through comprehensive Reservoir Fluid Analysis.

Think it over—and call the Core Lab representative nearest you.

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"If it's worth coring, it's worth analyzing."

CORE LAB

PETROLEUM RESERVOIR ENGINEERING

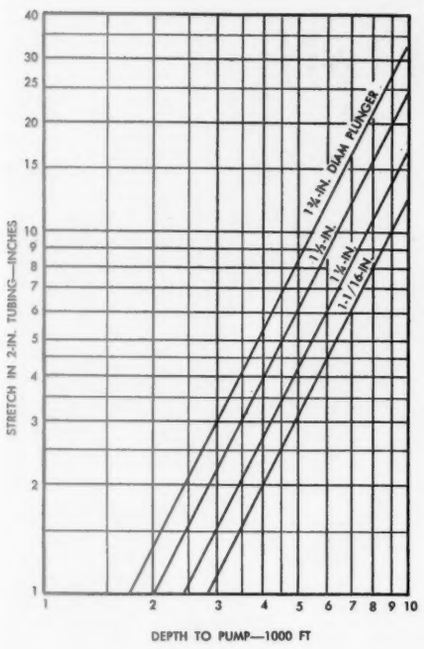


Fig. 1

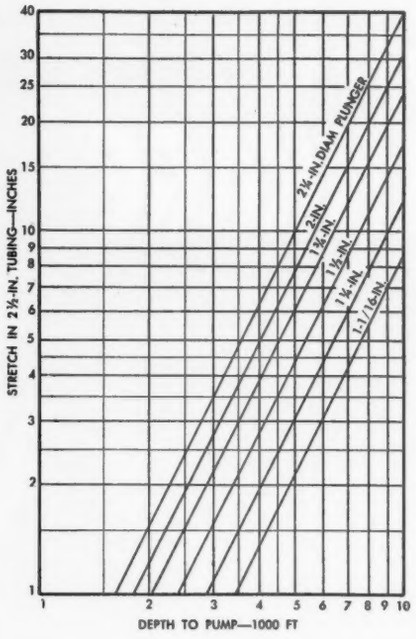


Fig. 2

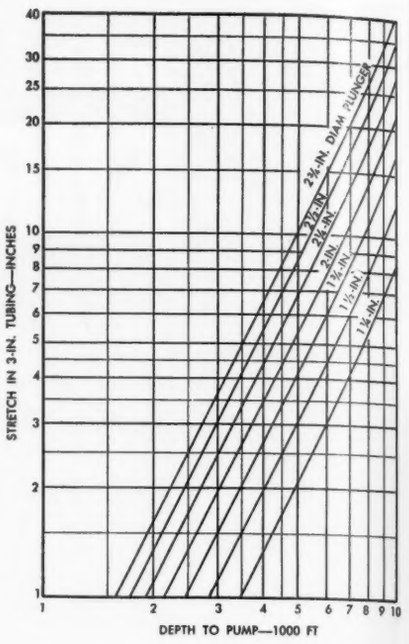


Fig. 3

EXCLUSIVE

Tubing Stretch and Pumping Efficiency

KENNETH N. MILLS†

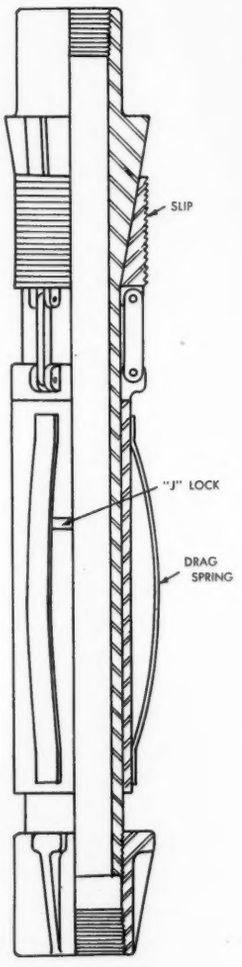
TUBING stretch is one of the causes for low pump efficiency in a sucker rod pumped well which can be eliminated. Tubing stretch reduces the efficiency of the pump, because it reduces the effective length of the plunger stroke, and this effect is induced by the action of the pump. The action of the pump alternately loads and partially unloads the tubing string as the fluid load is transferred from the sucker rods to the tubing. On the upstroke, the fluid load is carried by the sucker rod. When the plunger starts down this load is transferred to the tubing. If the tubing is suspended from the surface, and is free to move in the casing, this action will cause a loss in effective plunger stroke, because the tubing will contract when the load is removed and elongate when it is applied.

As the pump action alternately loads and partially unloads the tubing, it is subjected to a dynamic fatiguing load which can contribute to tubing failures, and leaks at tubing couplings. As the tubing is continually moving with reference to the casing it will cause coupling wear where it contacts the casing and this action will cause casing wear. As corrosion and stress are closely related this dynamic load on the tubing should increase its rate of deterioration. It should have this effect, because it will tend to prevent the formation of an oxide film over points being attacked by the corrosive medium in the well.

As tubing stretch reduces the effective length of stroke at the pump it reduces the amount of fluid produced. The amount of this loss is proportional to the ratio of the plunger stroke with the tubing fixed at the pump to the effective plunger stroke with the tubing free. The magnitude of the stroke loss due to tubing stretch for 2-in.,

†Assistant Chief Mechanical Engineer, Emsco Derrick and Equipment Company, Houston, Texas.

Fig. 4



In this new casing head . . . with 19 different interchangeable combinations of suspension and seal . . .

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CAMERON . . . oil industry pioneer in the use of molded rubber seals for pressure control equipment . . . again offers oil producers an improved type casing head. And, again, Murray engineers collaborated with Cameron engineers in developing the oil and acid resisting rubber component for this unique casing head, just as we have done on practically all Cameron rubber requirements for many years.

Murray provides the facilities of the South's largest and most modern mechanical rubber manufacturing plant, *plus* a complete machine shop for producing customer's molds, inserts, dies and fixtures. Bring your rubber molding problems to Murray.

MURRAY RUBBER COMPANY

HOUSTON, TEXAS

Murray Rubber

2½-in., and 3-in. tubing with various sizes of plungers is shown graphically in Figs. 1, 2, and 3. As the stroke loss due to tubing stretch increases with the square of the well depth, the magnitude of this loss increases rapidly as the well depth increases and it becomes a loss of major proportions in deep pumping wells. As the pump plunger size determines the magnitude of the load fluctuation imposed on the tubing, the amount of stroke loss due to tubing stretch increases as the plunger size is increased.

The stroke loss due to tubing stretch can be eliminated by anchoring the tubing to the casing near the pump. When the tubing is anchored to the casing, the forces causing tubing stretch are transferred to the casing and therefore are not imposed on the tubing. Tubing anchors are available in two general types. One type of tubing anchor is set by rotating and moving the tubing vertically in the well, and the other is set by the hydrostatic head pressure of the fluid inside the tubing. A typical mechanically set tubing anchor is shown in Fig. 4. This anchor is run into the well as a part of the tubing string, and it is located near the pump. After the tubing has been lowered to the desired point, it is rotated several turns to the right to unlock the "J" lock. Then it is lowered to set the slips through the resistance of the drag springs on the casing. After the slips are set, the tubing should be raised at the surface until about half of the weight of the tubing is suspended on the tubing head. If the tubing is not properly set on the anchor and too much load is placed on the anchor, the tubing will tend to "corkscrew" in the casing. This will cause excessive friction on the sucker rods and excessive well loads. The dynamometer card shown in Fig. 5 was taken on a well with the tubing improperly set on a tubing anchor. The dynamometer card shown in Fig. 6 was taken on the same well with the tubing raised to remove the "corkscrew" from the tubing. When these two dynamometer cards are compared, it will be noted that the well load was reduced approximately 8000 psi by correctly setting the tubing on the anchor.

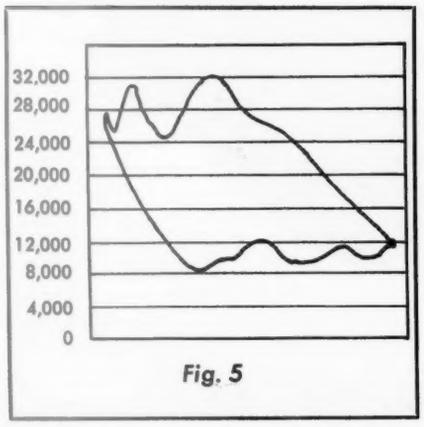


Fig. 5

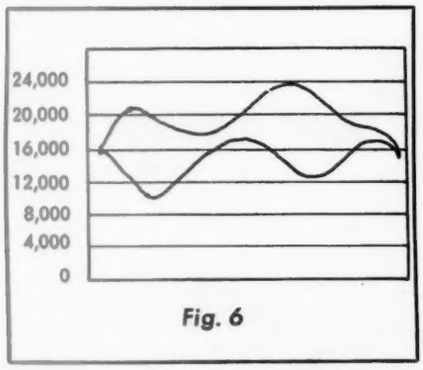
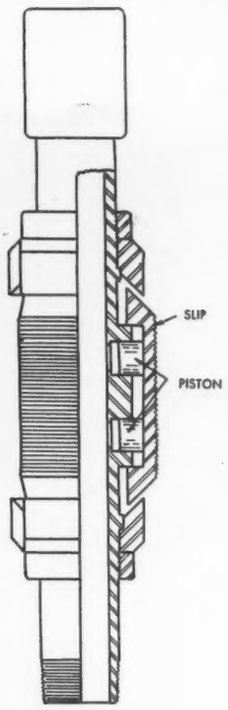


Fig. 6

Fig. 7



One make of hydraulically set tubing anchor is shown in Fig. 7. This tubing anchor consists of three slips which are set against the casing by the hydraulic pressure inside the tubing acting as pistons which contact the slips. This tubing anchor is run into the well as a part of the tubing string above the pump. The hydraulic pressure required to set the slips is obtained by pumping the well up, and it is not necessary to manipulate the tubing to set the slips or adjust the tubing loading. If this type tubing anchor is used in a well fitted with a tubing pump or a well where a rod type pump might become stuck, a tubing drain should be used to remove the hydraulic pressure from the slip actuating pistons.

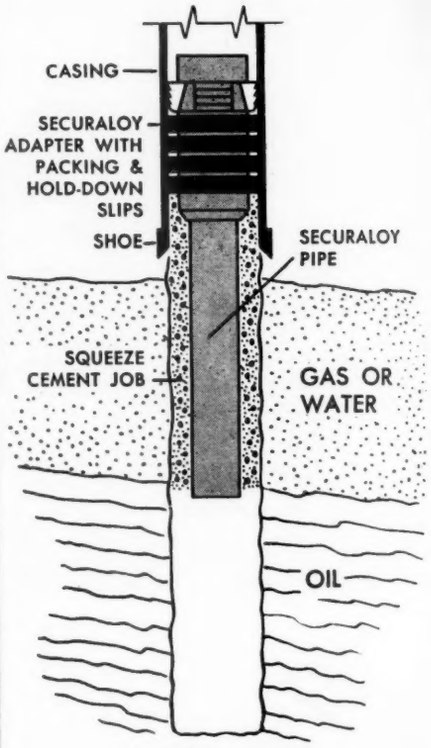
* * *

USE OF SECURALOY SOLVES MANY PRODUCTION PROBLEMS

Securaloy pipe, which may be removed with chemicals or a drilling bit, is being used to solve many "difficult" production problems, such as correcting gas-oil ratios, water shutoffs and plug backs.

CORRECTING GAS-OIL RATIOS

This method is similar to that used in the case history shown on the opposite page except that the Securaloy pipe extends through the gas zone to the top of the oil zone.



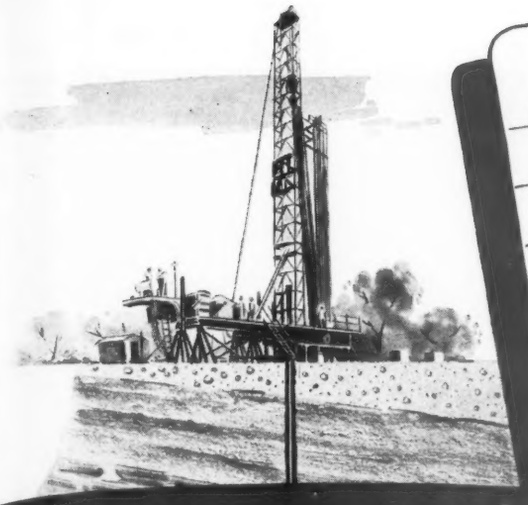
Securaloy set on top of producing zone

This method is used where the entire oil zone can be produced from open hole and where it is not necessary to confine the oil production to selective strata. The hole through the oil zone is first filled with gravel. Securaloy pipe is run and squeeze cemented in position. When the cement has set, Securaloy cementing shoe and gravel are cleaned out and well is ready for production, with gas or water successfully under control.

SECURITY ENGINEERING CO., INC.

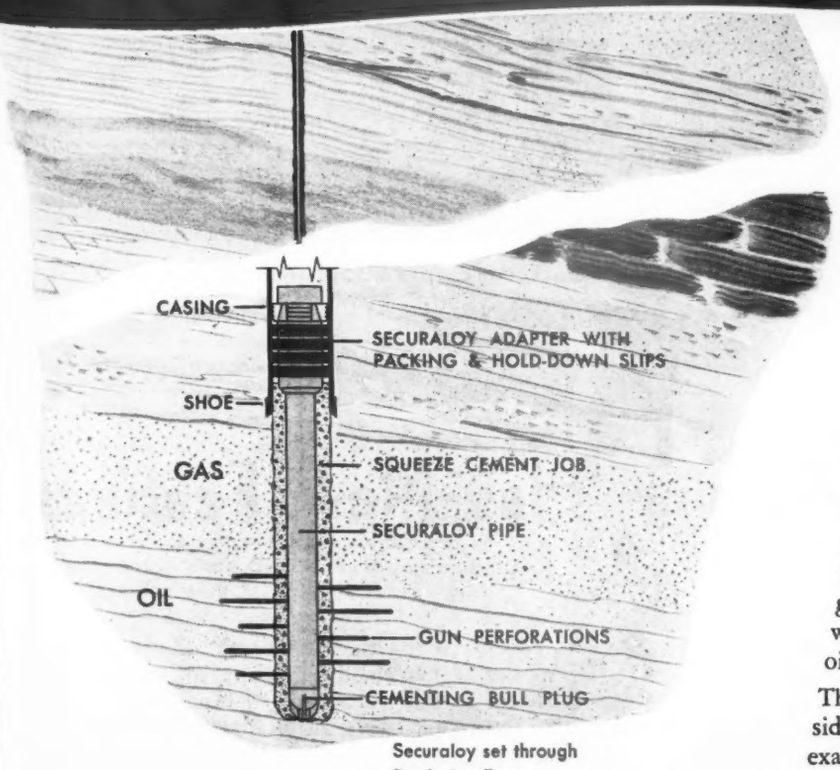
ONE OF THE DRESSER INDUSTRIES

Main Office and Plant: Whittier, California
Branches in all of the major producing areas
Export Office: Chanin Building, New York City



LOCATION: Texas
GAS-OIL RATIO: 300 to 1
PRODUCTION: 5-6 barrels per day on pump
QUESTION: How to increase production and lower gas-oil ratio by a simple and satisfactory remedial method

Too much gas—Too little oil?



Securaloy set through Producing Zone

When a Texas operator found his gas-oil ratio too high and production way down he determined that the positive way to correct this situation was to use Securaloy. You, too, can profit by using Securaloy to solve your gas-oil ratio problems.

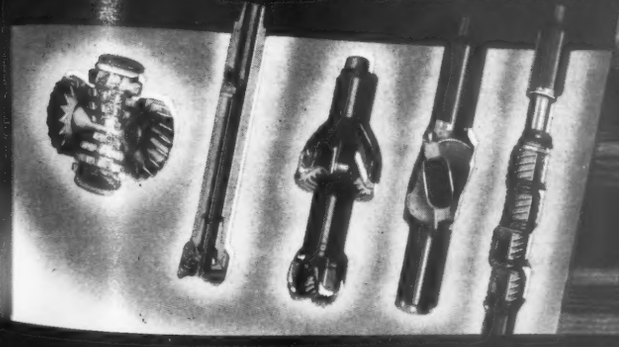
This operator first tried a plastic squeeze job, but the well still made only 6 barrels per day. Then a cement squeeze job was performed, with the entire open hole left full of cement and then drilled out. This proved unsuccessful too!

Finally, the operator cemented Securaloy pipe through the gas-oil sands, as shown. Selective strata were gun perforated and acidized. The well was then completed for 80 barrels of oil per day with a 40 to 1 gas-oil ratio!

This same remedial method is now considered standard practice . . . Another example of the application of Securaloy to solve your production problems.

Security

ROCK BITS • CORING BITS • HOLE OPENERS • REAMERS • CASING SCRAPERS

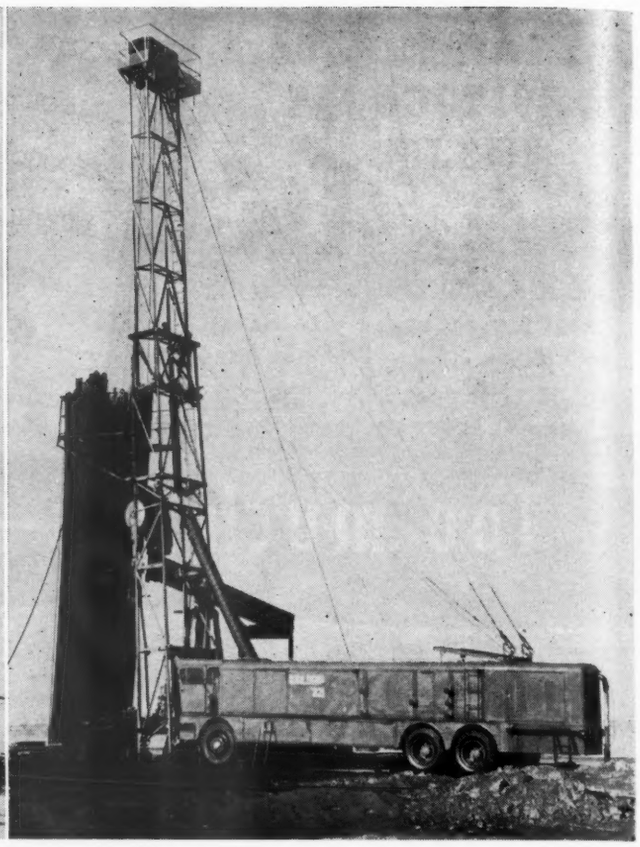


Securaloy

PRODUCTION EQUIPMENT

SECURITY ENGINEERING CO., INC.
ONE OF THE DRESSER INDUSTRIES
Main Office and Plant: Whittier, California
Branches in all of the major producing areas
Export Office: Chanin Building, New York City

Machine raises and extends telescoping derrick.



Stacked in derrick is 5200 ft of 2 ½ in. tubing.

Well Servicing Machine Has New Features

A NEW well servicing machine,[1] called the "Road-runner" by west coast oilmen, features a drive-in design that eliminates the difficulty usually associated with backing onto location. It employs other modern innovations such as a torque converter hydraulic drive to the vehicle as well as to the hoist, power controls at the derrick leg, and telescoping portable derrick of tubular construction.

In an attempt to improve upon the weight and arrangement in conventional truck designs, the company* planned this unit "from the ground up" using axles and power divider[2], their own light weight frame, aluminum body structure, and cab. Other features include automatic extension of the derrick while raising, automatic locking of the two sections of the derrick when raised and extended, automatic extension and retraction of the tubing board, shaftless drums, direct air high-low clutches in the ends of the drums, and aluminum crown frames and pillow blocks. Because of these features, a design has been achieved that is exceptionally light weight. (It is completely legal in California even when fully loaded with the 90-ft derrick.) The machine is easy to handle on the highway and in moving onto the location.

When on the highway, all that can be seen is a smooth, streamlined shell. A 65-ft or 90-ft derrick of tubular construction telescoped to a length of 41 ft or 47 ft is carried on top of this shell. Derricks have respective hook load capacities of 90,000 lb and 120,000 lb. The base or foot part of the derrick is carried at the forward or cab end of the machine, which is opposite to the usual arrangement. The double drum hoist, engine and torque converter, tool and accessory compartment, derrick raising mechanism, and vehicle drive mechanism are all enclosed inside the body shell. The engine[3], located at the rear, drives forward through a torque converter[4] to which is fastened a forward and reverse transmission giving two speeds forward (direct and low) and one reverse. The drive out of the transmission goes through a right angle gear box providing power to the hoist and into a transfer case that provides driving power to the wheels, thus giving torque converter operation to both the hoist and the vehicle over the road. One interesting comment on this operation is that the machine has been driven over the well known "Ridge Route" between Los Angeles and Bakersfield in California without shifting gears. The hoist, which is driven from

[1]Manufactured by Waldrip Engineering Company.
*Waldrip Engineering Company.
[2]Manufactured by International Harvester Company.

[3]Available as diesel or gasoline; Waukesha 145GK and General Motors 6-71 diesel are among the engines used.
[4]Twin Disc or Torcon.

Magcobar's My-Lo-Jel keeps water loss mighty low

FIELD REPORTS PROVE IT!

• Magcobar MY-LO-JEL is an improved pregelatinized drilling mud starch in the form of a free flowing powder which can be added directly to the mud through a hopper mixer. It provides positive control of the filtration properties of mud even in the presence of salt, anhydrite and other contaminants. MY-LO-JEL is a blended starch that is especially processed to produce a quick acting, tough and chemically stable plugging agent to inhibit filtration of mud. Thus, it not only lowers the water loss, but keeps it low.

MY-LO-JEL is economical to use. Two to four pounds per barrel of mud is all that is needed to impart the low water loss desired of most muds. It has a stabilizing effect on mud which often greatly reduces the cost of maintenance while drilling. Low water loss muds made with MY-LO-JEL are doing much to hold down the present day cost of drilling by eliminating strings of protection casing, preventing delays due to reaming, hole trouble and fishing jobs.

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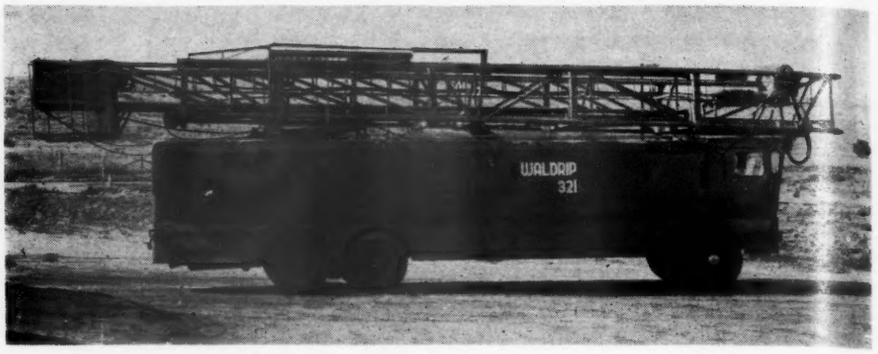
a countershaft coming out of the right angle gear box, is equipped with air clutches located in each end of the main drum with a different ratio drive for each end, giving an instantaneous two speed high-low shift. The sand reel is driven by a single air-ring clutch in the end of the sand reel drum. All chains run in oil and are pressure lubricated.

Such a design includes the following features:

1. Drives onto location instead of backing on, permitting easy, fast spotting. In connection with this a removable pointer frame is used on the nose of the cab fastened to the bumper where it can be seen by the driver. All that is necessary for the machine to be spotted properly and accurately is for the driver to drive the machine onto location, touching the polished rod with the end of the pointer. The pointer being the correct length for proper derrick lean and being on the centerline of the machine puts the machine on the centerline and the right distance away from the well. On test, the machine has been setup and the blocks swung over the hole in seven minutes.

2. Proper weight and balance of the machine, with less load on the front wheels. As the center of gravity of the engine and drive mechanism, hoist, and derrick falls almost directly over the rear wheels, a major portion of the weight falls on the rear bogie assembly.



One of the "Road-Runners" in an over-the-road position.

3. Rear positioning of motor gives greater accessibility. Also the rear position of the motor increases safety, as the motor position is about 40 ft from the well head.

4. Easier to keep clean. As all the working parts, including brakes, clutches, drive chains and drive mechanism, are completely enclosed, the problem of cleaning the machine after servicing a wet well is simple. The machine is hosed off with solvent and the smooth outside finish wiped clean.

A body structure of aluminum alloy was selected, permitting complete panels that could be readily removed. Hinged access doors are also provided to enclose the lubrication point and the derrick raising controls. All lubrication of the hoist is accomplished from a single point. Further, major components such as engines and drums may be lifted out without disturbing the rest of the machine. A large hinged access door is also provided on the left side of the machine to give an opening into the tool or accessory compartment immediately behind the cab.

Detailed specifications can be obtained from the manufacturer. ★★

REMEMBER: GEOLOGRAPH LOGS WHILE THE WELL IS BEING DRILLED

MEMO

Call for Geograph Today!

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Odessa, Texas
Alice, Texas
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You'll only drill it once!—Be sure you include Geograph in all Drilling Well Estimates!

"TIME WILL TELL"
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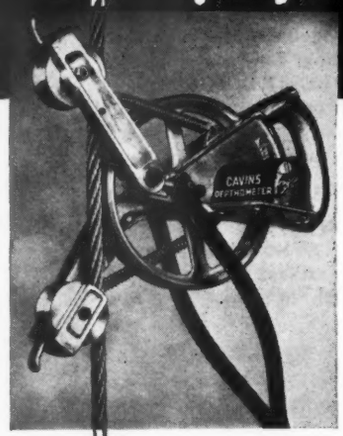

- Easy to Carry
- Direct Reading
- Quickly Put on Line
- Accurate Measurements

The Cavins DEPTHOMETER is a simple, compact, direct-reading device that obsoletes "stringing-in" and gives you accurate measurements in very little more time than it takes to make a trip with your bailer. Comes in a handy carrying case (weighs only 17 pounds)—readily taken to any well—put on the line in a few seconds—priced to pay for itself quickly.—Write for illustrated folder.

THE CAVINS CO.
2853 Cherry Ave., Long Beach 6, California

CAVINS DEPTHOMETER

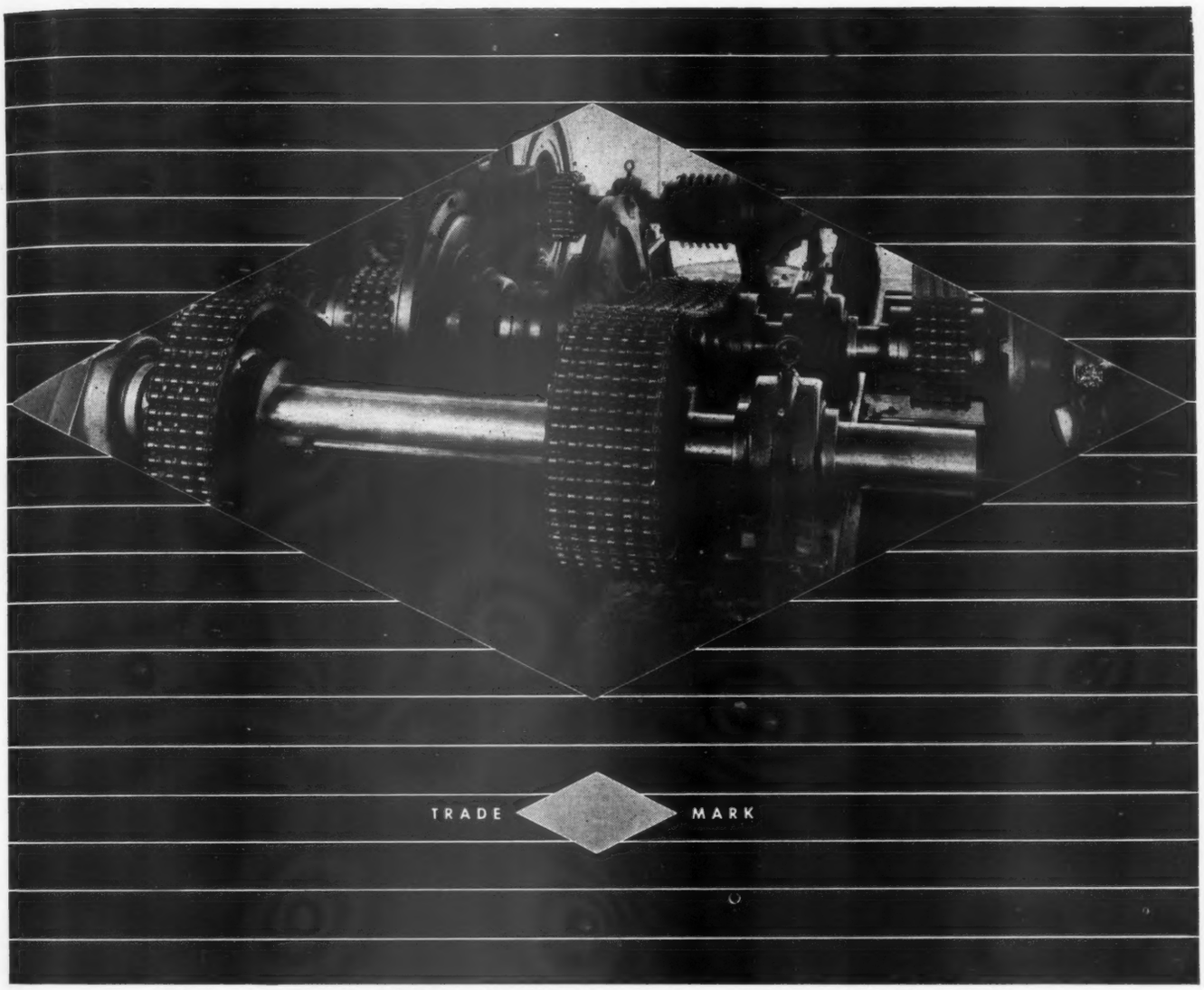

Illustration shows both Diamond Roller Chain Drives and Diamond Flexible Couplings.

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• Through nearly sixty years of continuous Roller Chain manufacture, the Diamond trademark has meant one unvarying standard of quality—the mark of excellence, reliability and integrity.

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DIAMOND ROLLER CHAIN DRIVES

Diamond Chain Company, Inc. *Indianapolis 7, Indiana*

TUBING LEAK TESTS

By RICHARD SNEDDON*

THERE are many factors that tend to interfere with the efficiency of oil well pumping, and in the main they are well recognized and pretty thoroughly understood. It is doubtful, however, if production men in general are cognizant of the extent to which production costs may be lofted and oil yield reduced by tubing leaks, regardless of whether they are collar leaks, pinholes, splits, or a combination of all three, as is usually found in defective strings. The effect of such leaks is obvious immediately. They start circulation of at least a portion of the oil back into the annulus through the leaky area. The degree to which this process asserts itself is, of course, determined by the size of the leaks, the pressure at the point of exit from the tubing, and the volume and viscosity of the oil. But, it definitely means that the potential pumping rate is reduced, the lifting cost per barrel is simultaneously increased, and the friction wear on tubing, rods, and pumping equipment is accelerated, necessitating more frequent pulling jobs and a more expensive maintenance program.

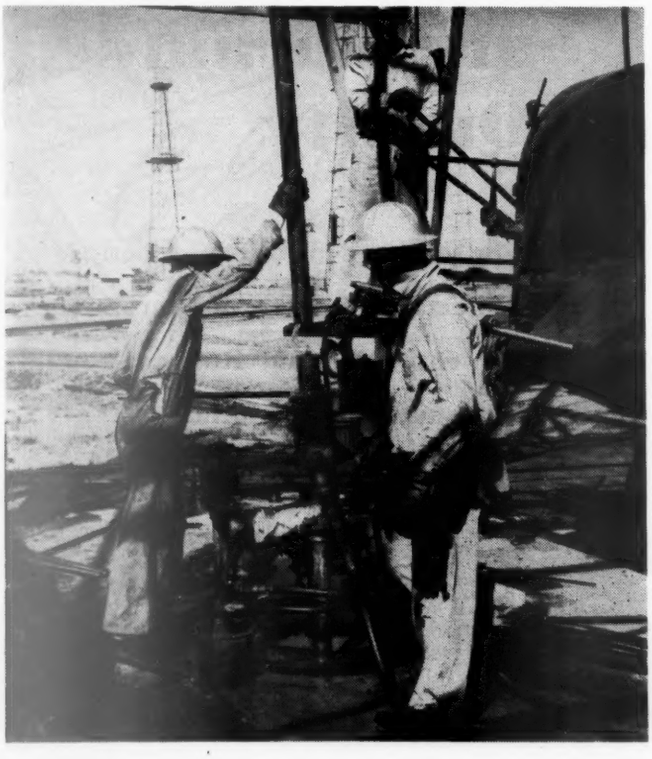
The causes of tubing leaks are now well known. Frequently they are due to the corrosive influence of oil well brines that eat slowly, or more often rapidly, through the metal. Much of the leakage is the result of friction or abrasion. It may come from the constant whipping of rods against tubing walls, or it may be caused by the intrusion of formation sand into the hole. This sand held more or less in suspension, especially if any turbulence is present, finds its way between working parts and abrades tubing walls and working parts, weakening the former and impairing the efficiency of the latter. These types of leak are usually determinable through measurement of wall thickness as they are the end result of a gradual disintegration of the metal.

There are, however, other kinds of tubing leaks that are not indicated necessarily by reduced wall thicknesses. There are the so-called "splits" that may be caused by undue stresses and strains, or by inherent defects in the tubing, not revealed in the normal course of inspection. They are in many instances simply ruptures of the tubing wall, and may occur either with or without a thinning of the metal. Pinholes may also be attributable in some cases to internal imperfections that exhibit themselves without any undue loss of wall metal. Whatever the cause of such splits or pinhole leaks, their effect is the same as has already been described in the first paragraph. They induce circulation of oil with consequent loss of production and all of the incidental inconveniences and expenses that inefficiency usually entails.

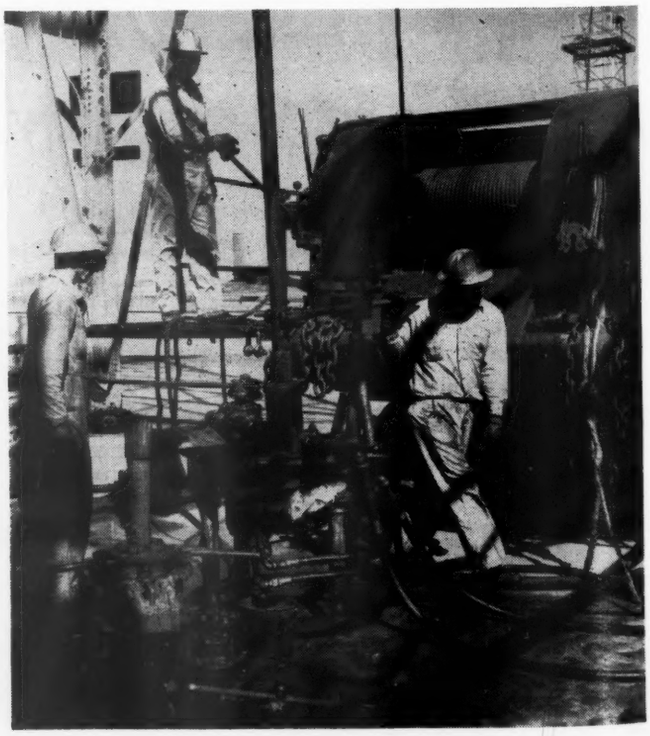
EXCLUSIVE

*Pacific Coast Editor.

Stabbing collar on hydraulic table preparatory to making up for water pressure tests. Tests described in this article ranged from 1500 to 3500 psi.



In this photo operator has just positioned the table-mounted tongs for making up the stand of tubing by hydraulic power on make-up and break-out table.



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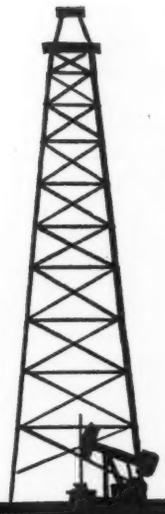

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It might be mentioned, also, that tubing leaks of all types are much more common than production men are inclined to believe. It is normally assumed that the development of leaks is a long, slow process and that it is futile to look for them until the tubing has been in the well for several years at least. But the development rate is, in reality, rather unpredictable, as it is affected by the prevalence of local stimuli of many kinds. It is apparent, for example, that tubing on the first day of its installation could conceivably be subjected to shocks and strains sufficiently violent to cause ruptures. And it is well known that corrosion, once begun under ideal circumstances, can progress at a very fast pace.

It is interesting to note that there has been perfected a simple, inexpensive, positive, and speedy method of determining tubing leaks, without regard to their nature.* This involves the use of a portable high pressure pump and a hydraulic make-up and break-out device, that completes a test of each tubing stand in 90 sec, and gives visible evidence of the leaks, if any. It is quite independent of all the usual symptoms and shows up every kind of leak, no matter whether it is accompanied by a reduction in wall thickness or not. The system is usually applied when the well is being pulled anyway, and all the operator is required to do is to put a plug in the top of each stand as it is broken. Then, as it is being put back into the well, each stand is temporarily jointed up to an adapter on the hydraulic tester table, which does its own making and breaking, and the stand is subjected to a water test at any desired pressure up to 5000 psi. The portable pump carries its own water container and is capable of filling a 3-joint stand of tubing in 17 sec, thereafter raising the pressure 200 psi per sec until the stipulated test pressure is reached. The stand is held under maximum pressure long enough to permit visual inspection for leaks that quickly show their presence in collars, threads, or in the body of the tubing. So far, equipment has been developed to test 2, 2½, and 3-in. tubing. Cold water is used, and occluded air is eliminated by discharge through the top plug that is provided with a ball check valve for that purpose.

The water pressure test is applicable under almost all normally encountered conditions, and can even be used in those instances where corrosion or wax accumulation has altered the circularity of the tubing interior. Employment of a packer or swab to seal off pressure has thus been prevented.

*By C & C Corporation, Long Beach, California.

TABLE 1. Summary of the tubing leak data obtained by hydraulic pressure tests by individual companies.

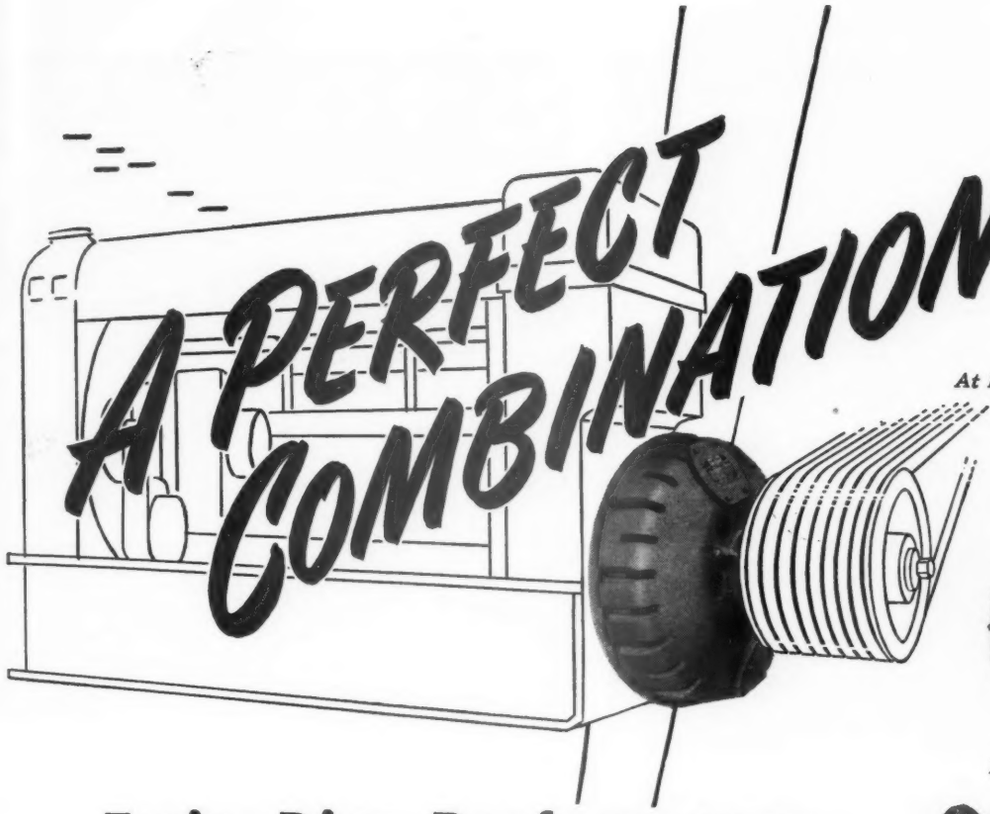
Company	A	B	C	D	E	F
No of tests	8	1	3	1	2	1
Footage	36,637′	5676′	13,812′	8010′	10,730′	2288′
Collar leaks	56	7	60	32	14	1
Pin leaks	9	0	8	1	1	0
Splits	9	0	1	0	8	0
Total leaks	74	7	69	23	23	1
Percentage of total leaks						
Collar	75.6%	100%	86.9%	95.7%	60.8%	100%
Pin	12.2%	0	11.5	4.3	4.3	0
Splits	12.2	0	1.6	0	34.9	0
Future savings in pulling jobs						
XX	9	1	6.9	2.5	8	
Leaks per foot (avg)						
Collar	644.1′	810.8′	230.2′	364.09′	766.4′	2288′
Pin	4070.7′	0	1726.5′	8101′	10,732′	
All	405.09′	810.8′	200.1′	348.2′	466.5′	2288′
Average leaks per test						
XX	9.25	7	23	23	11.5	1

Company	G	H	I	J	K	L
No. of tests	5	11	3	5	3	5
Footage	17,158′	15,659′	10,694′	26,476′	10,972′	21,779′
Collar leaks	24	130	36	45	26	49
Pin leaks	7	52	6	4	16	5
Splits	17	8	0	3	0	2
Total leaks	48	190	42	52	42	56
Percentage of total leaks						
Collar	50%	68.4%	85.7%	88.4%	61.9%	87.6%
Pin	14.5%	27.3%	14.3%	7.6%	38.1%	21.9%
Splits	35.5%	4.3%	0	4.0%	0	3.5%
Future savings in pulling jobs						
XX	17	8	2.10	3	2.1	2
Leaks per foot (avg)						
Collar	714.9′	397.3′	297.05′	588.3′	422′	444.4′
Pin	2451.1′	993.4′	1782.2′	6619′	685.9′	4355.8′
All	357.4′	271.8′	254.6′	509.1′	261.2′	388.9′
Average leaks per test						
XX	9.6	17.2	14	10.4	14	11.2

Company	M	N	O	P	Q	R
No. of tests	10	1	3	1	1	3
Footage	84,350′	1953′	23,132′	5884′	7400′	13,851′
Collar leaks	79	8	21	18	56	51
Pin leaks	23	0	8	0	3	1
Splits	3	0	1	2	0	3
Total leaks	105	8	30	20	59	55
Percentage of total leaks						
Collar	75.2%	100%	70%	90%	94.95%	92.7%
Pin	21.9%	0	26.6%	0	5.05%	1.8%
Splits	2.9%	0	3.4%	10%	0	5.5%
Future savings in pulling jobs						
XX	5	1	3	2	5.9	3
Leaks per foot (avg)						
Collar	1067.7′	244.1′	1101.5′	326.8′	132.1′	271.5′
Pin	3667.08′	0	2891.05′	0	2466.6′	13,851′
All	803.3′	244.1′	771.06′	294.2′	125.4′	251.8′
Average leaks per test						
XX	10.5	8	10	20	59	55

Company	S	T	U	V	W	X
No. of tests	1	1	1	1	3	5
Footage	4400′	2592′	2520′	13,068′	25,543′	25,543′
Collar leaks	5	11	1	7	33	45
Pin leaks	3	1	3	2	11	4
Splits	8	4	0	0	0	4
Total leaks	8	16	4	9	44	53
Percentage of total leaks						
Collar	62.5%	68.75%	25%	77.7%	75%	84.9%
Pin	37.5	6.25	75	22.3	25	7.55
Splits	0	25	0	0	0	7.55
Future savings in pulling jobs						
XX	2	4	1	1	4.4	4
Leaks per foot (avg)						
Collar	880′	235.6′	2520′	822.8′	398.9′	576.6′
Pin	1466.6′	2592′	840′	2880′	1188′	6385.7′
All	550′	162′	630′	640′	297′	481.9′
Average leaks per test						
XX	8	16	4	9	15.6	10.6

Company	Y	Z	A[1]	B[1]	C[1]	D[1]
No. of tests	5	1	2	2	10	17
Footage	32,055′	6324′	7100′	6624′	43,833′	72,370′
Collar leaks	67	11	9	30	186	427
Pin leaks	15	0	4	11	35	118
Splits	0	2	2	1	10	26
Total leaks	82	13	15	42	231	571
Percentage of total leaks						
Collar	81.7%	84.6%	60%	71.4%	80.5%	74.8%
Pin	18.3	0	26.6	26.1	15.1	20.6
Splits	0	15.4	13.3	2.5	3.4	4.6
Future savings in pulling jobs						
XX	8.2	2	2	4.2	10	26
Leaks per foot (avg)						
Collar	478.4′	574.9′	788.8′	220.8′	235.6′	169.4′
Pin	2137′	0	1775′	602.1′	15.1′	613.3′
All	390.9′	486.4′	473.3′	157.7′	189.7′	126.7′
Average leaks per test						
XXX	16.4	13	7.5	21	23.1	33.5



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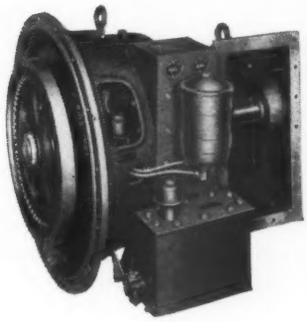

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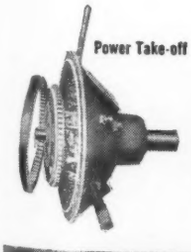

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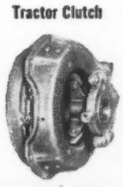

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Making up a stand after test is completed. All that remains to be done when it is put back in hole is to remove top plug, while raising elevator for next stand.

Manipulating the controls on the high pressure pump after the stand had been connected up to the system. Note the pressure gauges, placed for easy reading.

When the test on each stand is completed all that remains to be done is to remove the plug from the top end. Ordinarily, the plugs are furnished by the servicing company and the operator is merely required to put them in as each stand comes out of the hole, the actual running of the tests being carried on by the servicing company with the portable tester.

The hydraulic pressure test may be used, without the table, to check the tubing string right in the hole. This is done by employing a retrievable plug and suitable top and bottom packer assembly. It has certain advantages, notably that no prearrangement is necessary, and that all collars are tested in the makeup position. If a well has been pulled on the supposition that the pump is bad, for instance, and no pump trouble is discovered, it would obviously be an inconvenience to have to put a plug in the top of each stand, after they are all stacked in the derrick. Testing in the hole with the plug and packer system under such circumstances would certainly present the most simple solution. Incidentally, this method has been used effectively to check the power string on a self-surfacing hydraulic pump unit. It should not be forgotten, however, that when a test of the tubing is planned during a pulling job, the table system is eminently satisfactory. It gives visible evidence of leaks, and is independent of several factors that at least on occasion are present to interfere with an adequate test by the plug and packer method.

TABLE 1. Summary of the tubing leak data obtained by hydraulic pressure tests by individual companies (continued).

Company	E[1]	F[1]	G[1]	H[1]	I[1]	J[1]*
No. of tests	21	15	4	22	10	16
Footage	100,567′	69,072′	26,094′	119,122′	36,144′	77,114′
Collar leaks	186	277	53	203	75	259
Pin leaks	12	90	26	46	1	48
Splits	9	31	0	3	1	37
Total leaks	207	398	79	252	77	344
Percentage of total leaks						
Collar	89.8%	69.5%	67.8%	80.5%	97.4%	75.2%
Pin	5.8	22.6	32.2	18.2	1.3	13.9%
Splits	4.4	7.9	0	1.3	1.3	10.9%
Future savings in pulling jobs						
XX	9	31	4	15	4	37
Leaks per foot (avg)						
Collar	540.6′	249.3′	492.3′	586.8′	481.9′	297.3′
Pin	8380.5′	767.4′	1003.6′	2589.6′	36,144′	1606.5′
All	485.8′	171.2′	330.3′	427.7′	469.4′	224.1′
Average leaks per test						
XX	9.8	26.5	19.7	11.4	7.7	21.5

*Miscellaneous companies.

The results of some 204 tests conducted in various California oil fields by the water pressure method, with the hydraulic table, at pressures ranging from 1500 to 3500 psi, disclose that tubing leaks are much more prevalent than one might ordinarily assume. Of course, it should be rememberd that in almost all cases the tests were made at a time when the well was being pulled, and a pulling job doesn't usually take place until there is some good reason for it. Nevertheless, the forementioned tests, covering wells of widely varying depths and ages, indicated an average of 16.4 leaks per string tested, with a high of 59. By far the greatest proportion of these are collar leaks, which amount to about 77 per cent of the total. Also, it should be emphasized that while the number of leaks may be less important than their size, it would be safe to wager that all small leaks are merely incipient big ones, and that the damage that can accrue and the loss that can result even from small leaks, well

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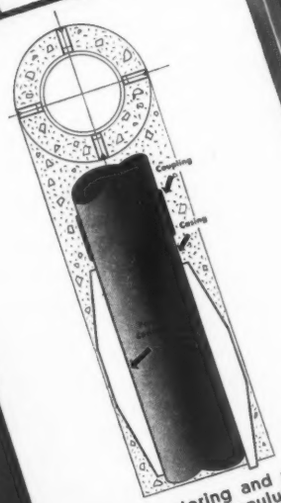

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TABLE 2. Summation of tubing tests on 204 California wells by water pressure, with use of hydraulic make-up and break-out table. Test pressures varied from 1500 to 3500 psi.

Number of tests	204
Tubing footage	1,002,763
Collar leaks	2,588
Pin leaks	574
Splits	187
Total leaks	3,349
Precentage of total leaks:	
Collar leaks	77.3
Pin leaks	17.1
Splits	5.6
*Estimated pulling jobs saved	345
Tubing footage tested per lead found:	
Collar leaks	387.1
Pin leaks	1746.9
All leaks	299.4
Average number of leaks per string tested	16.4
*Estimated future pulling jobs saved per string tested	1.69

*Calculated that one split or 20 collar or pin leaks would represent one future pulling job.

justifies the cost of testing the tubing string by the method outlined.

It is somewhat startling that in all the tests, representing a total tubing length of 1,002,763 ft, only a very few wells were found to be entirely free from leaks. In general, the discovery of leaks in the tubing should not only open the way to immediate correction with a saving in overall lifting costs and a higher production rate, but at the same time it should considerably lengthen the interval between future pulling jobs, or cut the number that will be necessary, which amounts to the same thing. From experience in the observation of production conditions, the results of the tests have been transposed into terms of pulling jobs, and it may be noted by reference to the accompanying tabulation that the removal or repair of leaky tubing in the series of tests under discussion resulted in a saving of some 345 pulling jobs, or about 1.69 per test.

These statistics are derived, as stated, from a compilation of some 204 tests conducted in scattered California fields. Actually, they are the first tabulations out of a total of 556 tests that have been run to date, and nothing so far evident in the remainder of the tests would indicate that the conclusions reached here should be changed. There is little doubt that tubing leaks are responsible in many instances for the inefficiency of oil well pumping, and that tests of the tubing can be made with the certainty of locating such leaks, by either of the methods here discussed. The reduction of future well pulling jobs and the immediate increase of production, which are the obvious result of correction, appear finally to justify the inconvenience and cost of such tests, and to warrant a careful survey of any situation in which the tubing may be under suspicion. ***

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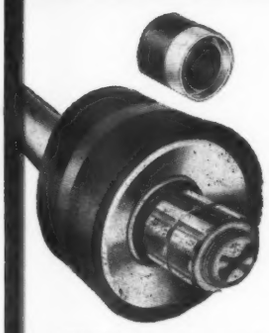

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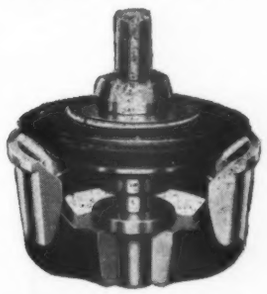

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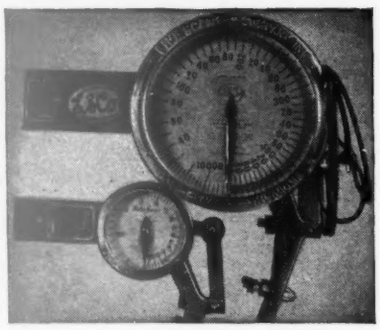

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Pre-Pennsylvanian Deepening Operations

THE Fairport Pool, Kansas, was discovered in November, 1924, and subsequent development found commercial production in the Shawnee and Lansing-Kansas City group. The majority of the wells were completed in these zones. No production was obtained until rather recently in the Pre-Pennsylvanian. Some of the wells on the apex of the structure had been deepened with the result that granite was found immediately below the Kansas City. This discovery led to the belief that no Pre-Pennsylvanian production would be obtained except on the flanks of the anticline and then only at subsea datums too low for commercial production. Recent deepening operations, however, have proved this theory to be erroneous. It has been found that good production is obtained frequently from the Arbuckle and/or Reagan sand adjacent to and on the flanks of the granite "highs."

As the majority of the wells were completed originally at a depth of about 3000 ft with 5½-in. casing, the problem of deepening these wells became of paramount interest. In those wells that had 7-in. casing, the problem was relatively simple, because a well could be deepened in the usual manner either with rotary or cable tools. As it was desired not to contaminate previous low pressure producing zones with rotary mud, however, cable tools were used to deepen the wells. In addition, it had been proved by past experience that deepening small diameter holes with rotary equipment was both a difficult and extremely hazardous operation.

The problem of deepening wells through about 300 ft of interbedded shells of limestone without being able to carry a string of pipe was thought at first to be insurmountable. After much trial and error, however, it was found that these wells could be deepened without undue risks.

The technique used in deepening these wells is as follows: the tubing and rods are pulled, the cable tool spudder or beam unit is then moved onto location, and the deepening operations are carried on in the usual manner with the exception that bailing of the hole is held to an absolute minimum. Any new or additional pays encountered in these operations are not tested, but samples and fillups are recorded. During initial deepening operations any new pay zone that was encountered was tested, but it was found that many days were required before the hole could be "cleaned up" and drilling operations resumed. When the objective horizon (the Arbuckle or Reagan sand) is reached, deepening operations are stopped and the hole is allowed to reach a static condition. Bailing and drilling are also prohibited during this interval.

The next operation consists of running a flush joint liner in the hole. If the original casing was 5½-in., a 4½-in. flush joint liner is used. Where the original casing was 7 in. in diam, a 5½-in. flush joint liner is used. These liners are equipped with a baker liner shoe and conventional baker expansion jars. The liner is run to the bottom on 2-in. tubing and attempts are made to fill the hole with water before cementing operations are commenced. Because of the fact that the Upper-Pennsylvanian producing sections are at extremely low pressure, the hole does not fill even after displacing twice the volume of water required. As soon as attempts to fill the hole have failed, cement is pumped into the tubing and the tubing and casing pressures are carefully watched. Generally speaking, it will be noted, after having pumped in 300 to 400 sacks of cement, that the annular space is filling with a corresponding increase in the tubing pressures. Just as soon as this condition is noticed all cementing operations are stopped. The tubing is then backed off, any excess cement circulated, and the tubing removed from the hole. After waiting for the cement to set, the hole is bailed down and the liner tested to see whether or not an adequate seal has been secured. The shoe is then drilled and the well completed in the conventional manner.

Normally a deepening job such as has just been described requires from 16 to 30 days to complete, the time depending upon the caving condition of the hole. If a minimum of caving is encountered, the well is naturally completed in a shorter length of time than when greater caving occurs. It appears that the success or failure of these operations are dependent upon whether or not the hole is tested prior to running the liner and whether or not a minimum of bailing is conducted. It is the natural inclination of anyone in the oil industry to want to test any producing section, but past experience has definitely indicated that untold expense will usually result if any testing is done while these deepening operations are under way. A careful analysis of the samples and fillups together with a correlation of the subsea datums will usually determine whether or not a commercial producer will be obtained.

—By Russell Raymond Voorhees.

ALL READY *for fast make-up!*

● Why? Because Republic Electric Weld Casing and Tubing are uniform throughout every length and every shipment . . . uniform in diameter and roundness . . . with uniformly clean, accurate threads that take hold and spin up tight in a hurry.

These *modern* tubular products provide valuable underground protection, too. Uniform wall thickness . . . adequate metal under the threads . . . and sound, scale-free inside surface all combine to offer high resistance to pull-out and collapse.

Republic Electric Weld Casing and Tubing are formed only from high ductility steel. Every length is fully normalized for uniform structure. Casing is cold sized for high yield strength—additional assurance of full dependability on every job.

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NORMALIZED CASING AND TUBING

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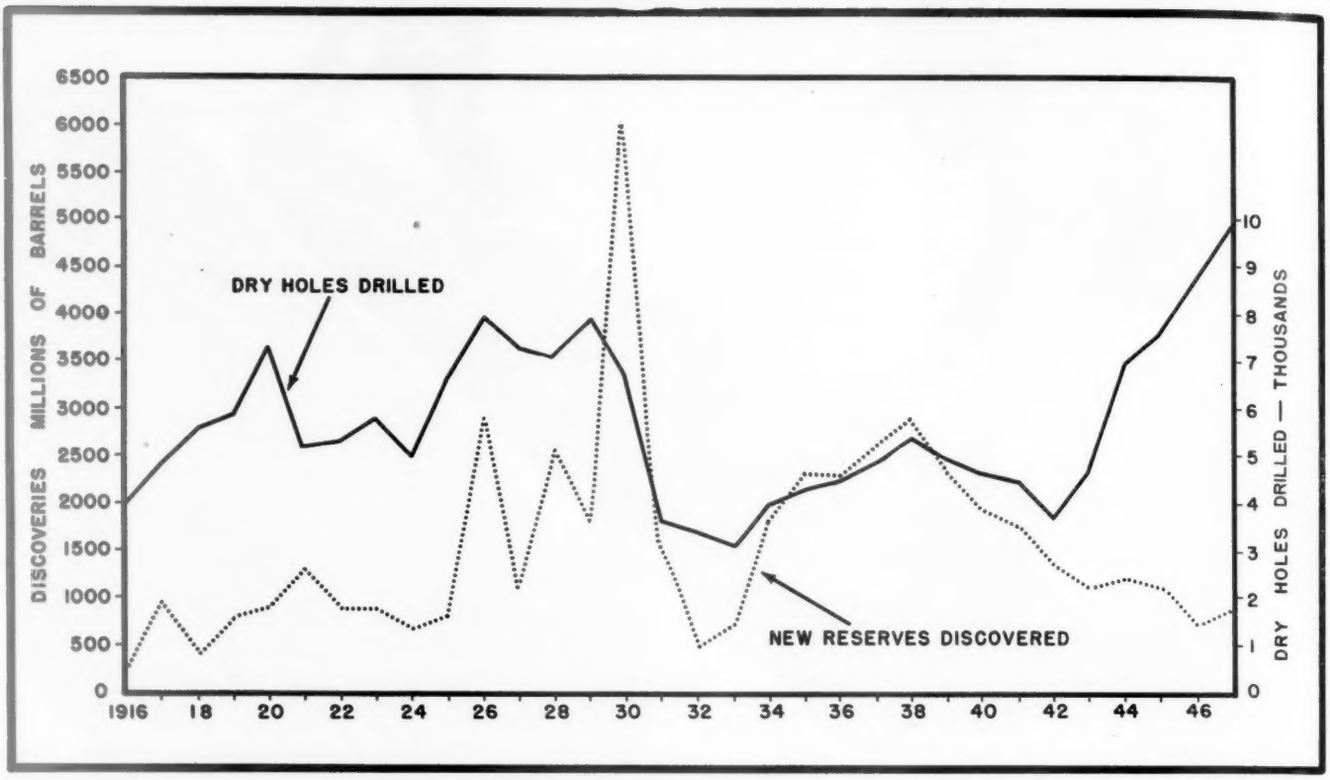
REG U S PAT OFF

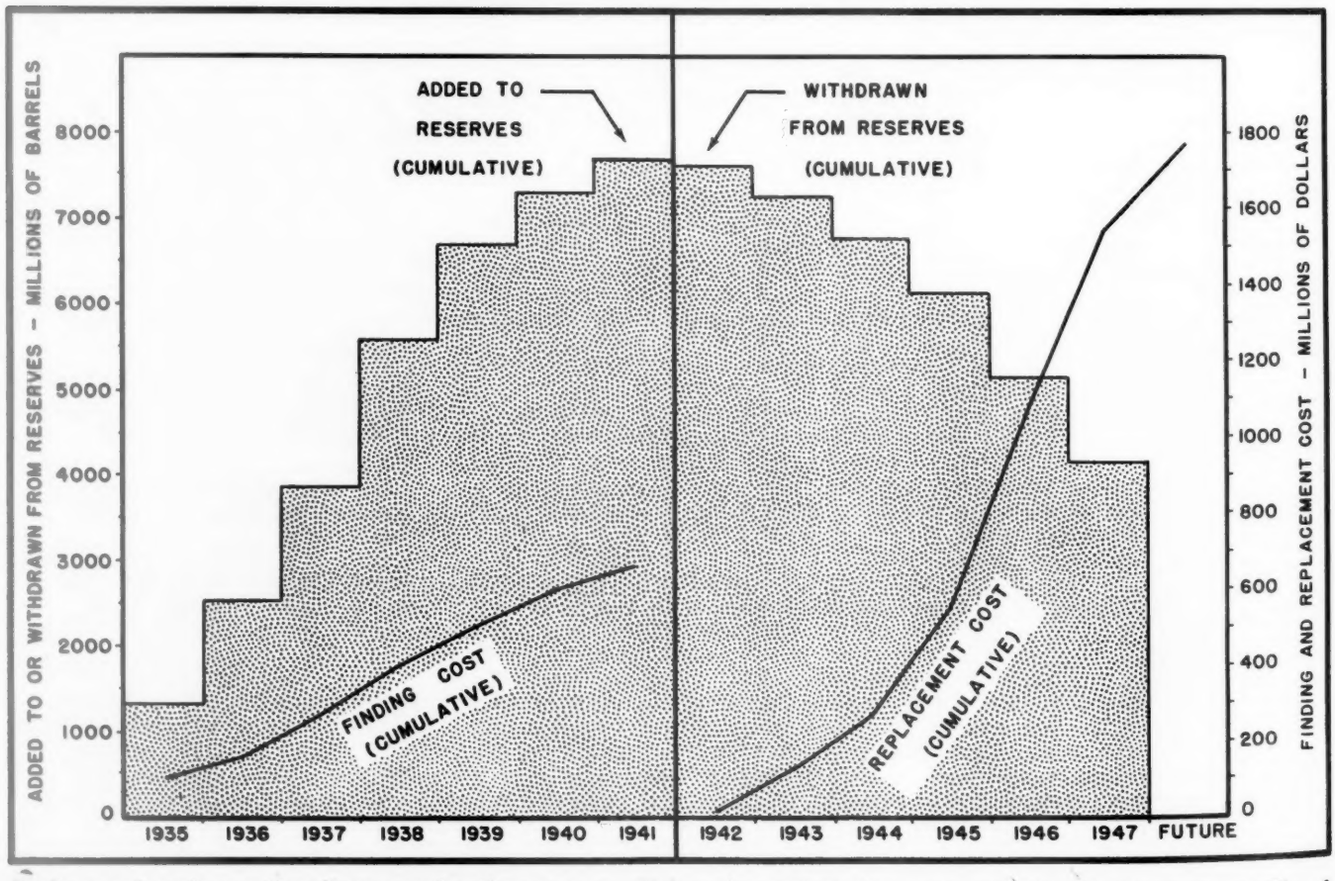
Other Republic Products include Line Pipe—Carbon, Alloy and Stainless Steels—Upson Studs, Bolts and Nuts—Electrunite Heat Exchanger Tubes

DRY HOLES DRILLED AND DISCOVERIES



It took 12 dry holes to lead to discovery of a million bbl in 1946-47, against only 2 dry holes per million in 1926-30. Effort to find oil indicated by dry holes drilled is greatest in oil industry's history.

RESERVES REPLACEMENT COSTS

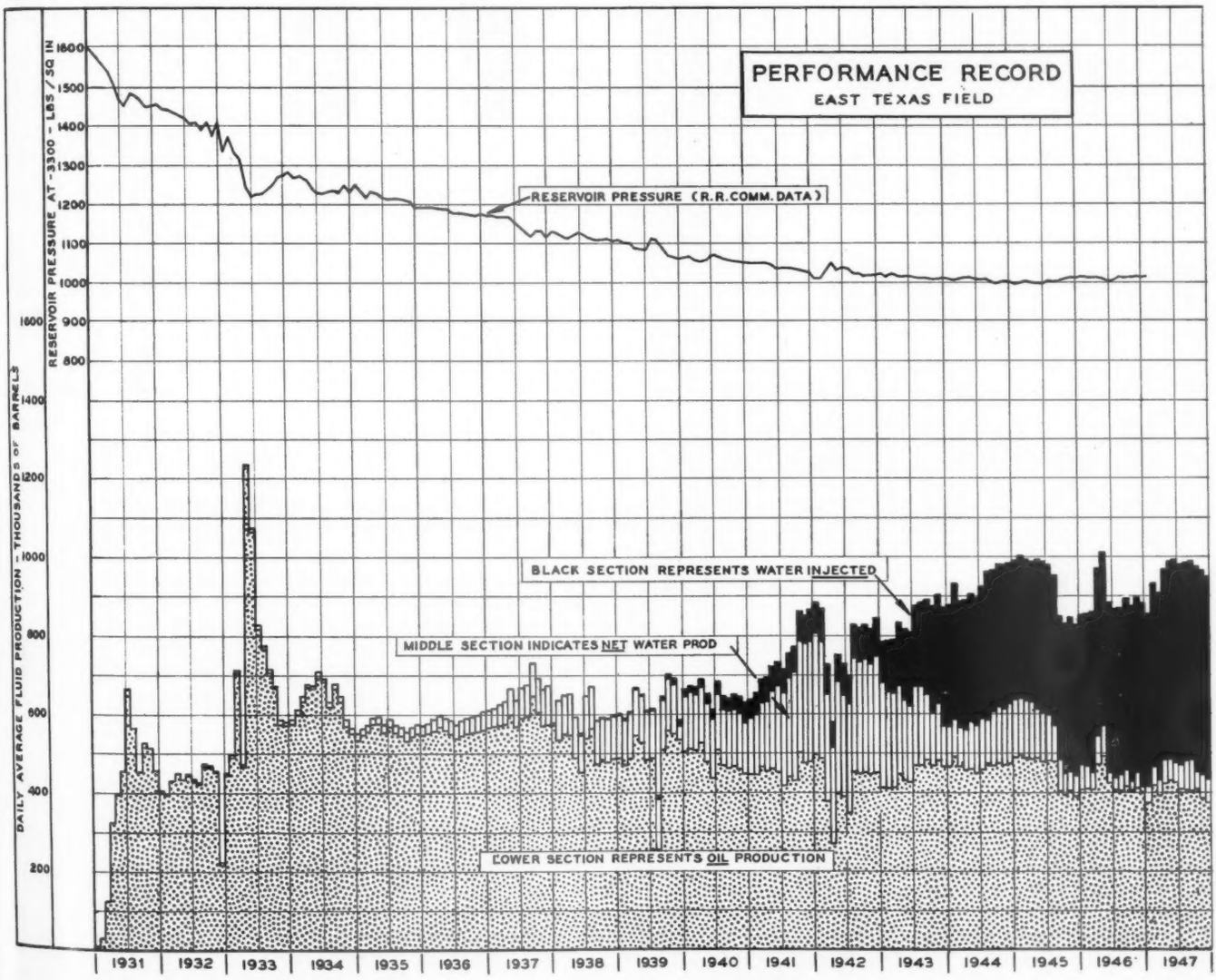


Replacement costs are five times greater than prewar—50.6 cents against 10.1 cents per bbl. Oil discovery credits of 1935-41 that cost $657 million involve a replacement cost of $3,294 million.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

FLUID WITHDRAWALS AND RESERVOIR PRESSURE—EAST TEXAS FIELD

Year and Month	Daily average production—Barre				Water injected per day (Barrels)	Net fluid withdrawal per day (Barrels)	Reservoir pressure 1st of Month (Psi)
	Oil (Tank)	Oil and gas (Reservoir)	Salt water	Total fluid			
1943 Total	128,568,647	—	145,503,540	—	73,642,841	—	— 3.27
Daily	352,243	455,877	398,640	844,517	201,761	642,756	—
1944 Total	134,768,033	—	170,423,237	—	124,136,102	—	— 11.20
Daily	368,219	466,100	465,637	931,737	339,169	592,568	—
1945 Total	131,021,969	—	176,152,000	—	137,179,479	—	+ 14.91
Daily	358,964	454,385	482,608	936,993	375,834	561,159	—
1946 Total	120,574,115	—	174,661,000	—	156,009,005	—	+ 0.05
Daily	330,340	418,152	478,523	897,776	427,422	470,354	—
1947							
January	300,039	379,796	474,000	853,796	436,347	417,449	1016.20
February	330,663	418,561	512,000	930,561	469,699	460,862	1014.46
March	313,021	396,229	509,000	905,229	471,474	433,755	1013.73
April	336,417	425,844	541,000	966,844	482,976	483,868	1013.45
May	340,137	430,553	554,000	984,553	501,651	482,902	1007.89
June	336,005	425,323	562,000	987,323	509,712	477,611	1005.08
July	323,985	410,108	565,000	975,108	499,558	475,550	1012.85
August	323,242	409,167	576,000	985,167	503,213	481,954	1007.21
September	319,492	404,420	584,000	988,420	506,460	481,960	1003.90
October	322,796	408,603	566,000	974,603	523,078	451,525	1001.76
November	304,773	385,789	577,000	962,789	517,372	445,417	1003.95
December	295,352	272,863	572,000	945,863	509,939	435,924	1009.51
1947 Total	116,934,858	—	200,552,000	—	180,450,380	—	— 4.81
Daily	320,369	405,531	549,458	954,989	494,385	460,604	—



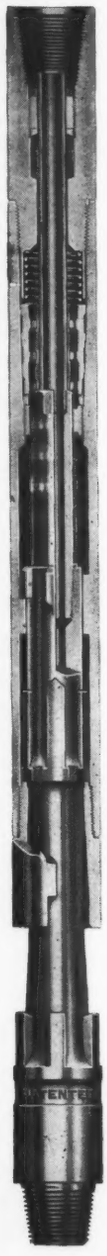
Source: W. S. Morris, Vice President and General Manager, East Texas Salt Water Disposal Company.

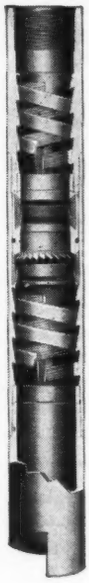
From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

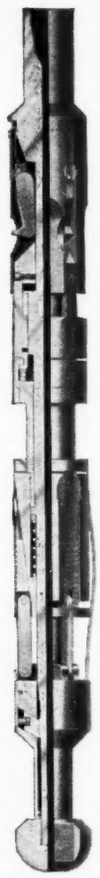
EXPERT TOOLS FOR Export Jobs!

FOR EXPORT drilling work — where elimination of every possible risk of equipment and manpower is demanded today —choose your fishing tools carefully! Be sure to look for the operating features that reduce fishing hazards to the core . . . insure greatest safety for men and equipment . . . and place maximum working effectiveness on the fish under all conditions.

Check the features of the Bowen Fishing Tools illustrated here. Then you'll know why, for every fishing problem, field-proven Bowen Tools are the logical choice for your overseas drilling operations . . .







Here's a straight-pull Fishing Jar (left) that requires no dangerous torque for operation, yet is fully adjustable for intensity of blow while in the hole. It strikes as many as ten hard jarring blows per minute—average—to keep the fish moving once it's started.

This Bowen Spear (above left) is a simple, safe tool for all spear jobs. It has a trouble-free releasing mechanism—never known to fail—and a bull-dog grip that safely withstands hours of steady jarring operations.

The Bowen Releasing Overshot (above right) catches drill pipe, tool joint or coupling without changes or adjustments. Incorporates special spiral grapples that cinch tighter as pull increases, yet releases easily when required. Made also for catching pipe, tool joint and oversize drill collar.

The Bowen Inside Cutter (right) for casing, drill pipe or tubing is engineered throughout for accurate and safe cut-and-pull operations. Fully stabilized while cutting, does not crawl once set. Can be reset for additional cuts without coming out of the hole.

Take these outstanding fishing tools along wherever you drill. And write for the complete Bowen Catalog which gives full details and ordering information on the entire line . . . valuable for export ordering!

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NEWS

California Sets Mark

California oil field operations were at a record high last year, with 2802 notices to drill new wells filed with the state division of oil and gas, well above the previous high of 2252 in 1944.

A new production record also was established when crude oil production exceeded 340,000,000 bbl, compared with 336,600,000 bbl in 1947 and 328,200,000 bbl in 1945, the wartime record.

Important discoveries last year included those by Standard Oil Company of California in Kettleman Middle Dome; Norris Oil Company and Richfield Oil Corporation in Cuyama Valley; Barnsdall Oil Company in Fresno county, eight miles east of Coalinga; and Hancock Oil Company in Kern county, 2½ miles northeast of Ten Section field.

Stream Pollution

The Sanitary Water Board of the Pennsylvania Department of Health has adopted measures intended to prevent stream pollution by wastes from petroleum and natural gas production. Although the text of the rules and regulations adopted by the Sanitary Water Board and their effective date were not immediately available, J. P. Jones, director of production for the Pennsylvania Grade Crude Oil Association, said the recommendations submitted by the oil and gas associations called for provision to be made for pits in which oil wastes could be accumulated and then burned. Also included were plans for settling and overflow devices to remove sediment and guard against washing out of wastes by stream flow.

Retired with Honors

Earl J. Carnahan and Jack Magee of the General Petroleum Corporation were honored recently at a banquet given by their colleagues of the company's production department at the Jonathan Club Los Angeles.

Both men retired on January 1, Carnahan from the post of superintendent of the southern division and Magee from the post of superintendent of equipment. Both men joined the company in the same month over 34 years ago—July, 1914.

Sixty-five members of the General Petroleum production department attended the banquet, which was presided over by Max App, vice president and director of production. Many of the men present had worked with Carnahan and Magee for over a quarter of a century, including Carnahan's successor, C. C. Gandaubert who has been with the company since 1920.

Baker Summarizes Gas Saving

Speaking before the Rotary club of Beaumont, Texas, during a program commemorating the forty-eighth anniversary of the Spindletop discovery, Hines H. Baker, president of Humble Oil and Refining Company, outlined the action being taken by the oil industry in Texas to conserve casinghead gas.

He stated that $250,000,000 is being spent in a post-war program, 40 per cent completed, to save nearly 2¼ billion cu ft of gas daily. When this program is completed in 1950, he said, 90 per cent or more of the casinghead gas that can be economically utilized will be conserved, compared with 70 per cent now. He interpreted recent action by the Texas Railroad Commission in seeking to close several fields only as a means of hastening industry action.

Schlumberger Branch Office

Schlumberger Well Surveying Corporation has recently opened its 67th field branch service office at Eastland, Texas, Roger Henquet, vice president and general manager of Schlumberger, has announced. Henquet, and R. D. Ford, public relations manager, flew to Eastland for opening day.

E. H. Cubertson, formerly in the Wichita Falls area, was promoted to district manager and will be in charge of the new Eastland operation.

J. A. de Lanoy *and his associates in Asiatic Petroleum Corporation were guests at the Nomad luncheon honoring de Lanoy, at Louis Sherry's, New York, in December.*

Seated at the table are: S. J. Veenstra, Asiatic Petroleum Corporation; George R. Woods; J. A. de Lanoy, the honor guest; Val R. Wittich, Jr., Nomad president in 1948; Stewart D. Beckley, secretary; W. D. Robinson, sergeant-at-arms.

Below are a group of celebrants. In the back row are: J. C. Poulton, R. W. Parkinson, S. J. Veenstra, W. P. O'Malley, J. A. de Lanoy, T. G. Schad, W. J. Byrne, H. Hotchkiss, and A. Nilsson. Front row: C. F. Lunghard, J. Schneider, C. E. Staines, B. J. Joyce, L. J. van Dijk, J. Marciano, J. Thielen, E. F. Carney.

Pioneers' Party Big Success

On December 23, Petroleum Production Pioneers to the number of 500 assembled at the Los Angeles Breakfast Club for one of the finest meetings yet held by this fast growing organization. The date was a bit too close to Christmas to permit the out-of-towners to come in large numbers but they were well represented nonetheless. George Trembley, the extremely capable dispenser of cakling aqua, introduced an innovation that served very effectively to avoid congestion around the fountain. It was very simple—instead of one large dispensary, he had four small ones. Aiding in his laudable effort to dissipate all inhibitions were such popular purveyors of the oil man's nectar as Lee Laird, John Hills, Dutch Lortscher, Clint Eddleman, Ed Abbott, Bill Kinder, Joe Schlarb, Hudson Drake, and Charlie Perkins.

When the assembled throng was properly in tune, an excellent dinner was served, after which, with Prexy Jim Gosline in the chair, the annual meeting was held. The chief business transacted at this juncture was a motion to adjourn. Then came the introduction of guests, among them many old timers, including Frank Dinger, former tool designer with National Supply Company; R. A. Broomfield, former executive vice president of Bransdall Oil Comany; J. A. Dunn, president of Barnsdall; A. E. Fowks, former Union Oil Company executive with longest industry experience of any member of the Pioneers; R. P. McLaughlin, first State Oil and Gas Supervisor; Al Tietze, former general superintendent of San Joaquin Valley operations for Standard of California; Ed Stearns, vice president Universal Consolidated Oil Company; John Grier, Cable Tool Drilling Company; Len Little, former manager of field operations, Standard of California; F. J. Ripley, Sr., former manager of C.C.M.O. Company; Ben Youngken, pioneer National Supply Company engineer; W. O. Todd, old time contract driller; Frank Hill, former director of production for Union Oil Company; Frosty Martin, chairman of the Long Beach Harbor Board; Tom Hickey, pioneer supply man; Denny Driscoll, Baash-Ross tool designer and oil industry historian; and many others.

Entertainment of a high order was furnished by Cy Rubel who confounded the skeptics by playing some very sweet music on a common or garden saw, and offering to saw the leg off a table or its occupant to prove that he was using an ordinary joiner's implement; Tom Pike sang some snappy popular numbers in typical professional style, meantime playing his own accompaniment on the Steinway; Tut Tuttle, with his Cremonese Amati, made Fritz Kreisler's place in the musical world just a little less secure; Frank Thorne literally stopped the show with a couple of piano solos —Liszt's Hungarian Rhapsody No. 2, and Chopin's Minute Waltz. Frank is an ex concert pianist, now with Baker Oil Tools, and he has all the artistry of a virtuoso. For the windup, Chris Christanelli, the Baroid ambassador of goodwill, sang and played his piano concertina or whatever it is in his usual bangup style, while everybody joined in and shook the rafters. In all respects, although not so large as some of the previous parties, this was one of the best ever staged by the Petroleum Production Pioneers.

Lecture Series

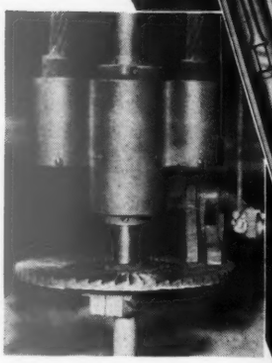
A lecture series in reservoir engineering was given by Dr. Morris Muskat under the auspices of the Department of Petroleum Engineering, The University of Texas, February 8-10, 1949. Subjects covered were: Relative permeability, condensate reservoirs, gas injection, gas drive performances, water injection well histories in water flooding, and partial water drives.

WHAT ARE YOU PAYING FOR PARAFFIN REMOVAL?

TOO MUCH — If your pumping wells are not equipped with HUBER SCRAPERS

Many major companies report Huber Scrapers have completely eliminated paraffin removal costs or reduced them to only a fraction of a cent per barrel of oil produced. Huber Scrapers, shrink-fitted to new or used sucker rods, scrape the paraffin from the tubing wall as the string rotates and reciprocates. Rods are rotated by the special Huber Rotating Rod Hanger.

Reduce or eliminate your paraffin removal costs with Huber Scrapers. Write for latest bulletin.



HUBER ROTATING ROD HANGER

This rod hanger rotates the rod string a fraction of a turn on each reciprocation. Two ratchet levers, operated by a flexible cable extending from the walking beam, engage the teeth in the turntable to turn the rod string.

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PARAFFIN SCRAPERS
SCRAPE AS THEY ROTATE AS THEY RECIPROCATE

Performance Counts Again..

LINK-BELT Roller Chain *Helps Smash 4 Drilling Records!*

Deep Well Breaks Four Drilling Records
By NICHOLAS A. D'ARCY, JR.
THE Rocky Mountain Drilling Company, drilling for the Standard Oil Company of California, broke three world's records and one California record in drilling Maxwell No. 1 near Ventura, California. This well, drilled to a total depth of 17,696 ft, was drilled in the fastest time to a comparable depth, is the deepest well ever drilled by a drilling contractor, is the deepest well ever drilled with power equipment, and is the deepest well ever drilled in California.
The well was remarkably free from trouble, until the pipe stuck at the final depth, but the most surprising feature of the entire performance was the splendid results obtained with the heavy duty power drilling equipment. The drawworks powered by four 6-cylinder diesel engines hoisted the long strings of drill pipe in about the same time required by conventional steam rigs in the same field. The slush pumps were overloaded to more than double their rated horsepower capacity, but they performed to the entire satisfaction of the contractor.
▶ Hoisting equipment. The entire rig was purchased in 1947, and it was described as a modern power rig capable of drilling 12,500-ft wells. It has lived up to and far exceeded its rated capacity. Maxwell No. 1 was the second well this rig drilled. The derrick and works itself is modern in every respect and similar to many power rigs designed for drilling to 12,000 or 13,000 ft, but it was never intended as a depth-breaking piece of equipment. Precision cut teeth sprockets, oil tight chain guards, friction drum clutches, and dual 40-in. hydromatic brakes with master cathead and spinning cat-heads are similar to the specifications on countless other similar rigs. It was careful supervision and maintenance that made this a record-breaking
Standard Oil Company's Maxwell No. 1, near Ventura, California, drilled to a depth of 17,696 feet by Rocky Mountain Drilling Company, using a diesel powered rig. This is the deepest well ever drilled with diesel power.
P 425.

The Rocky Mountain Drilling Company's rig, a National #125 equipped with standard Link-Belt Silverlink Roller Chain, broke 4 records in drilling 17,696 feet on California's Maxwell #1, near Ventura, for Standard Oil Company of California . . .

1 — World's record for fastest drilling time to comparable depth.
2 — World's record for deepest hole ever drilled by a contractor.
3 — World's record for deepest hole ever drilled with diesel power.
4 — California record for deepest hole ever drilled in the state.

That spells PERFORMANCE in capital letters for Link-Belt Silverlink Roller Chain . . . for these records were broken without chain trouble.

Maxwell #1 was the second well drilled with this rig.

Several pulls of over 300,000 lb. were made on stuck pipe . . . again proving that Link-Belt Silverlink Roller Chain can do more than deliver the power — it can take the shock loads too!

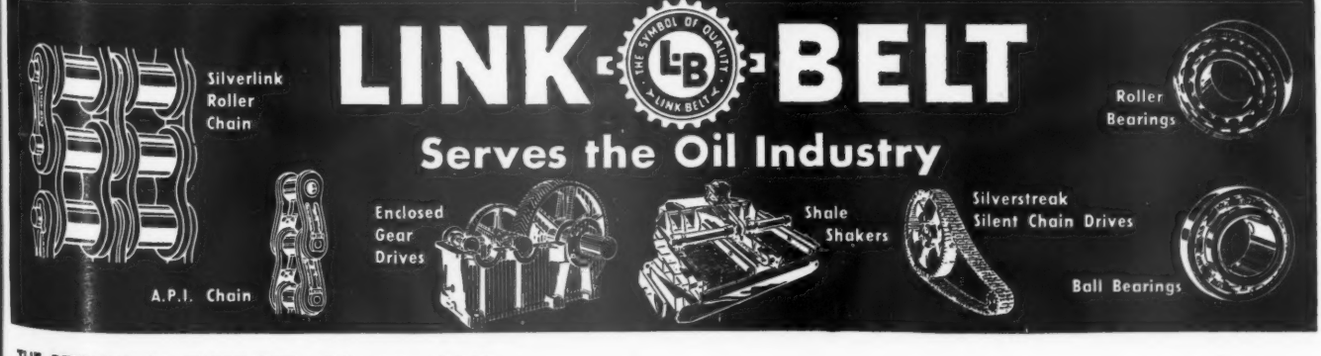
This Link-Belt chain performance is all the more impressive because this rig was only rated to drill 12,500 feet, and actually went down 17,696 feet — a depth overload of more than 40%!

Such performance proves why most rig manufacturers . . . and most operators . . . specify Link-Belt Silverlink Roller Chains!

LINK-BELT COMPANY

Indianapolis 6, Dallas 1, Houston 2, Kansas City 6, Mo., Los Angeles 33, New York 7, Toronto 8.

11,381



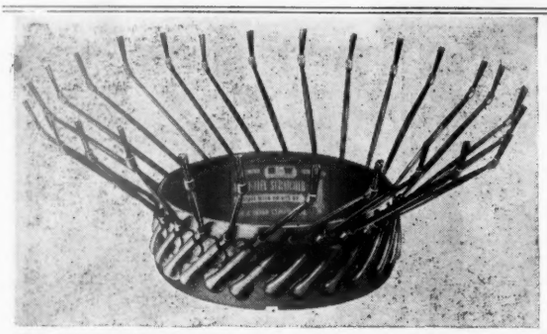
Core Profit-Sharing

Core Laboratories, Inc., national petroleum reservoir engineering firm, has announced completion of the first year of its employe profit-sharing plan. All employes having more than one year of service have been mailed bonus checks in amounts varying from 15 to 35 per cent of their present annual salary and computed upon years of service to the organization. W. H. Davison, president, states that the profit-sharing plan has reflected itself very favorably throughout the company's entire operations during the past year and a similar plan will be in effect in 1949.

—King Tool Company

Among the recent industrial additions to the Longview, Texas, area is the new King Tool Company, Inc., plant in Greggton. The firm manufactures pneumatic engine starters, truck tire changers, and a pipe handling devise for rotary rigs, items invented by the company's president, W. R. King.

The self-educated King says that the pneumatic engine starter puts an end to "hard to start" engine troubles and eliminates the usual danger of physical injury, because all the operator has to do is operate a quick opening valve.



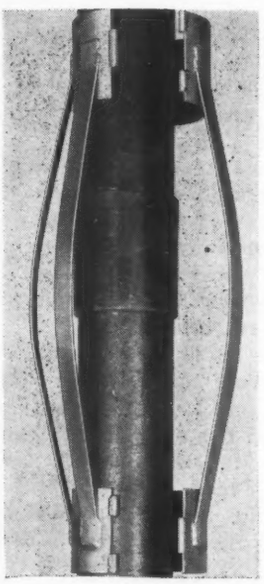
B and W Multiflex Scratcher

Remove Mud Cake, Center the Casing and You'll CUT CEMENTING FAILURES to the Core!

MORE AND MORE OPERATORS are getting better cement jobs the first time, eliminating need for squeeze cementing and saving thousands of cementing dollars with this B and W equipment. Here's how:

MUD CAKE REMOVAL is accomplished with B and W Multi-Flex Scratchers installed on the casing opposite the cementing zone. Strong multiple-wire fingers 5" long combine strength with reversibility . . . are flexible to adapt themselves to hole contour for minimum disturbance of the mud cake while running in . . . insure *complete mud removal* during cementing operations.

CASING CENTERING with B and W Latch-On Centralizers installed either at the rack or rotary table eliminates troublesome channeling, insures better cement bond between casing and formation. Split hinge construction makes installation easy on either collared or external upset casing . . . both straight and spiral types are available to meet all well conditions.



B and W Latch-On Centralizer

If cementing failures are robbing you of profits, plan *now* to use economical B and W equipment on well completions. We'll be glad to send you full details—write us today!

Don't Squeeze! . . . it CAN be avoided

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★ *Well Completion Specialists* ★

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New Offices

The firm of Stanley and Stolz, consulting petroleum engineers and geologists, has announced the removal of its offices to Suite 620 Security Title Insurance Building, 530 West Sixth St., Los Angeles 14, California.

Shell Acquires Properties

Shell Oil Company, Inc. has acquired the producing properties of the Petrolia Corporation in the Midway-Sunset field in Kern County. These properties include the Gore, Western Production Company and Wier leases, consisting of 210, 30 and 160 acres respectively. The Gore and Western properties are United States government leases. There are 33 wells producing approximately 190 bbl daily of 11 deg gravity oil. Also acquired in the purchase were two Luy leases covering 320 acres of undeveloped government land.

Ordinance Committee

A special committee has been created by the directors of Western Oil and Gas Association to work with its ordinance committee toward the development of basic information relating to the drafting of zoning ordinances regulating oil well drilling. The purpose is to enable the group to advise cities and counties with respect to the drafting of such ordinances. The membership of the new committee is as follows: L. L. Aubert, Bankline Oil Company; S. F. Bowlby, Shell Oil Company, Inc.; Harold L. Briggs, Chanslor Canfield Midway Oil Company; Sam Grinsfelder, Union Oil Company; Joseph Jensen, Tide Water Associated Oil Company; C. A. Johnson, Holly Development Company; Warren C. Johnson, Standard of California; F. A. Morgan, Richfield Oil Corporation, and T. J. Wood, Jr., The Texas Company.

Development of Hammon Field

Recent new oil well completions in the Hammon Oil Field, Wichita County, Texas, indicate that the field will be a good producer, according to announcement by Warren Oil Corporation and W. H. Hammon, joint developers of the field. Warren Oil is a wholly-owned subsidiary of Warren Petroleum Corporation.

The latest producing wells are the Cole 5-A and the Cole 6-A. The Cole 5-A has been completed for a potential of 348 bbl of oil daily. The Cole 6-A has made, on test, 101 bbl of oil through choke in 3¾ hours. Another well, the Cole 9-A has topped the Canyon Sand from which the other wells are producing, and casing has been set. The producing sand is at a depth of about 3000 ft.

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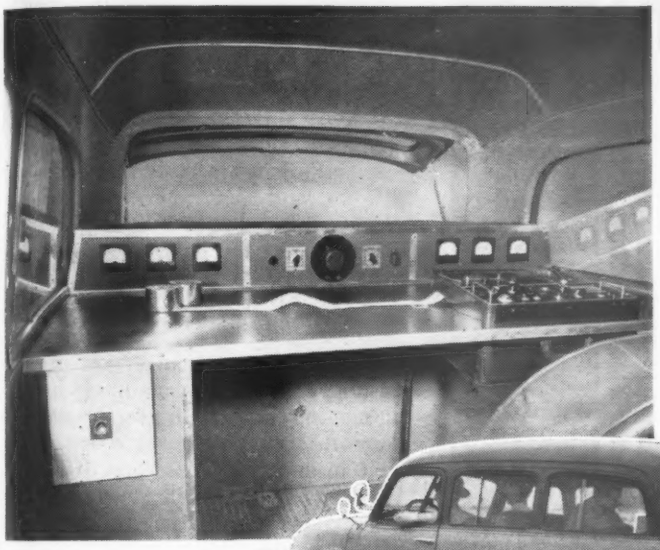

View of operator's instrument panel.

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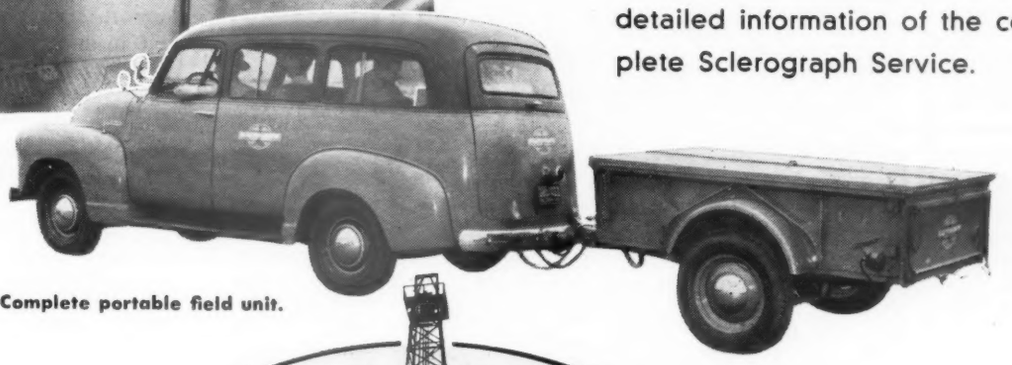

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Seaboard Moves Into Canada

Seaboard Oil Company has consummated an agreement with Barnsdall Oil Company and Honolulu Oil Corporation whereby Seaboard acquires a one-third interest in their Canadian operations, it was reported recently.

Barnsdall and Honolulu have been active in Alberta, Canada, since early in 1948 and have the operating rights on about 2,000,000 acres of land there. The agreement is on an equal participation basis.

Barnsdall has acted as operator for the joint interest since the entrance of the two companies into Canada and will continue in this capacity.

Los Angeles Nomads Elect Officers

As it usually does in the January meeting, Los Angeles chapter Nomads sat in closed session at the Jonathan Club on the evening of January 12, 1949. Winning the presidential poll, after a tough fight with Jack Ballagh, was Lee Laird of Howard Supply Company. The balance of the elected officers were as follows: Vice president, Earl Boggess, Baker Oil Tools, Inc.; sergeant-at-arms, Tommy Johnston, M. O. Johnston Corporation; secretary, George Flanders, Lane-Wells; treasurer, Earl Reese, Patterson-Ballagh; assistant secretary, Bill Riggins, Hydril Corporation; assistant treasurer, Knight Templeton, Champion and Smith, Inc.; deputy sergeant-at-arms, Ted Forsyth, Emsco. Two regents were also named—Bob Eiche of Eiche and Associates, and Fred Ripley, Jr., of Ideco.

Fred Ripley occupied the chair for his last meeting as prexy and it was easily one of the best gatherings of the year. Because of the business nature of the agenda, there were not as many guests as usual, but prior to the dinner, aided and abetted by an excellent singer and accordianist, the gang roared out the old songs in good style, with more vigor, of course, than accuracy. After dinner, Earl Boggess produced a trio of speakers, each of whom made a decided hit. Bart Gillespie, honorary member, and a highly regarded chap by everyone in western petroleum, was the guest of honor. He made a few short remarks indicating his pleasure at the reception he had had on his visit from the wilds of Alaska, and also made some odious comparisons between Arctic Circle weather and the current gale in Los Angeles.

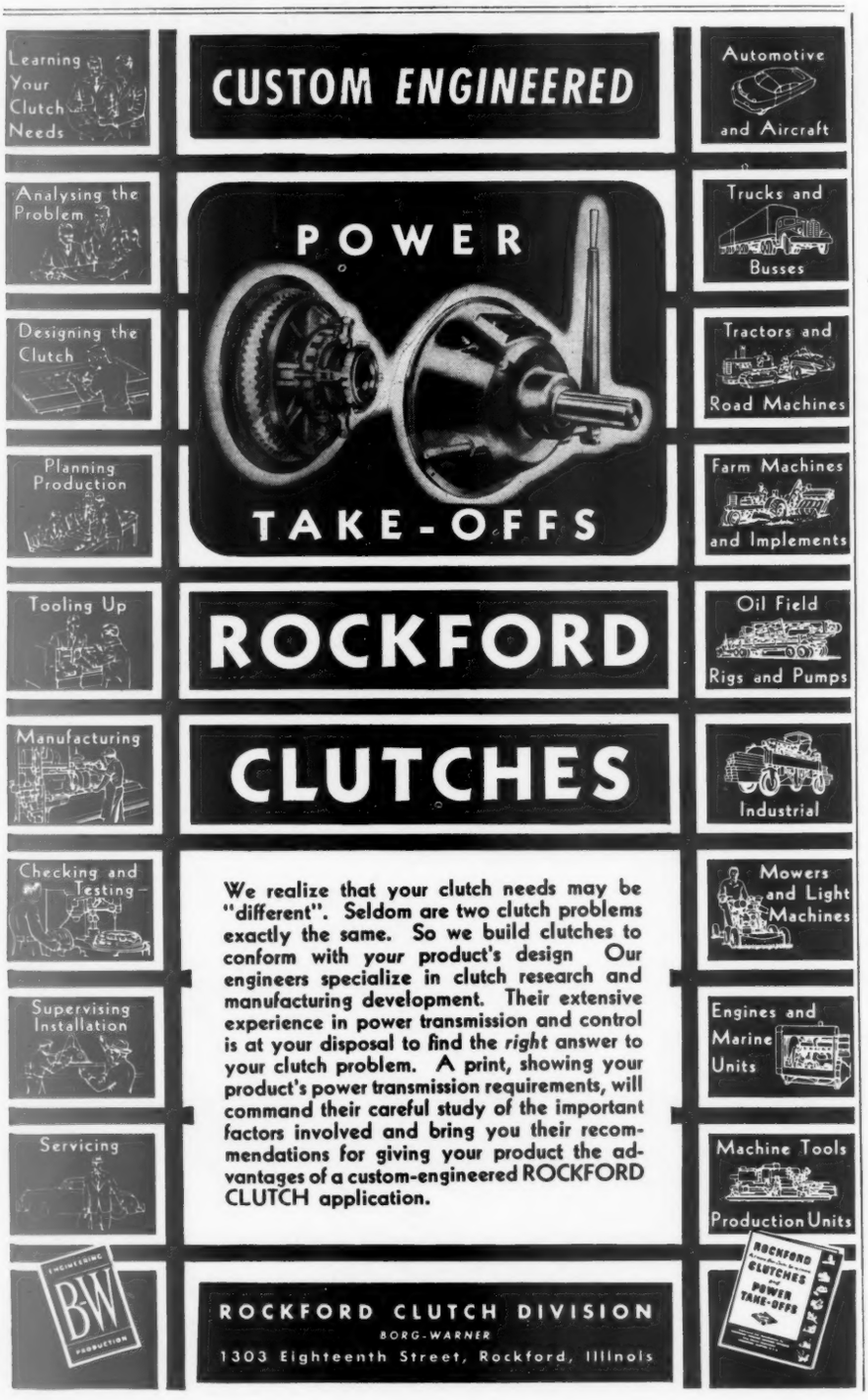
Nomad B. Reinhold gave an interesting account of his recent travels in Europe and not a soul missed a word of his colorful story. Reinhold has an intriguing accent, a grand sense of humor, keen powers of observation, and an unusually clear and deliberate manner of speech, all of which made his presentation a genuine treat. So also was the vigorous, rousing talk given by Bill Sargent, ex-Loyola football coach, and mentor, too, of several professional teams. Bill is a dandy story teller, and his description of famous coaches and their systems was a classic. He kept his audience in stitches for the forepart of his address and then changed to a more serious tone, handling the subject of youth delinquency just as capably as he did the humorous stuff.

Young County Well

Warren Oil Corporation, subsidiary of Warren Petroleum Corporation, has completed its J. T. Hamilton No. 1 Well in Young County, Texas. The well flowed 299 bbl in 12 hr and 40 min through a 24/64-in. choke. The producing formation is a sand in the Strawn series at 2900 to 2909 ft.

New Gas Field

A new California gas field has been discovered by Shell Oil Company, Inc. Its exploratory well, Pleasant Creek Unit 3-1, located 2½ miles northwest of the town of Winters in Yolo county is producing 10,000,000 cu ft of gas per day from a depth of 2820 ft.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Division Manager

Carl L. Larson, Jr., formerly Rocky Mountain division exploration superintendent for Stanolind Oil and Gas Company, has been named division manager, succeeding John F. Cullen, who became division consultant. William B. McCabe, division geologist, moved up to Larson's former position.

Larson started with Stanolind in

Carl L. Larson, Jr.

1934, as a helper on a torsion balance crew. He held numerous geological positions with the company before being named division geologist for the company's Texas-Louisiana Gulf Coast division in 1945. Larson went to Casper as division exploration superintendent in January, 1947. He has his B.A. and M.A. degrees in geology from the University of Illinois.

Rockwell Division to Expand

L. A. Dixon, Jr., has been appointed general manager of the Pittsburgh DuBois Division of Rockwell Manufacturing Company, W. F. Rockwell, Jr., president, announced. Con-

L. A. Dixon, Jr.

current with his appointment Dixon stated that expansion plans have been formulated to accelerate production in the company's tin meter operations, which constitutes the major part of this division's function.

Dixon started in the engineering department of the Pittsburgh-DuBois Company and was made executive vice president in 1944. When Rockwell acquired the company in 1947 he became the assistant general manager. The division operates plants in DuBois and Sykesville, Pennsylvania.

Opens Consulting Practice

George Y. McCoy, formerly with Republic National Bank of Dallas, announces the opening of offices for the consulting practice of petroleum engineering and geology. McCoy is located in the Empire Bank Building, Dallas 1, Texas.

Manages Houston Office

F. O. Walter has been appointed manager of the Houston office for Patterson-Ballagh Division of Byron Jackson Company. He was formerly in the purchasing department at Homco and has worked for Abercrombie. More recently he has been associated with McCarty Oil and Gas Company.

F. O. Walter

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A VERNIER WEIGHT INDICATOR gives the engineer a permanent record of each 24 hours of operation. The Gauge is placed in front of the driller where the slightest change in hook load or bit weight is instantly revealed.

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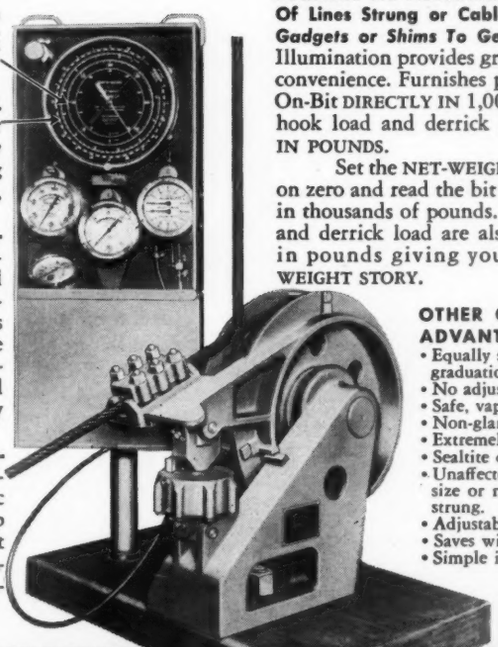

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James W. Foley

JAMES W. FOLEY has been appointed assistant to Vice President R. Ogarrio of The Texas Company's domestic producing department. He was formerly assistant division manager at Tulsa, and will now make his headquarters at New York.

Foley has had wide experience in both domestic and foreign oil operations. Born in St. Augustine, Texas, he was graduated from Texas A&M in 1932 with a B.S. in petroleum engineering. He started with The Texas Company in June, 1932, as a roughneck, and a year later became a petroleum engineer, first at Conroe and later in the Laredo district and the Rocky Mountain division. From 1937 to 1940 he was petroleum engineer for Bahrein Petroleum Company, Ltd., on Bahrein Island, in the Persian Gulf. Returning to this country, he was named district petroleum engineer at New Iberia, Louisiana, and later superintendent of the Erath unit operation. In 1944 he was transferred to New Orleans as superintendent of gas-gasoline operations, and in 1947 went to Houston as assistant to the manager of the producing department. A year ago he was named assistant division manager of the Oklahoma division at Tulsa.

His principal outside interest is his family and home. Having married Miss Gretchen Stewart of Green River, Wyoming, in 1937, he is now the father of two little girls, 5 and 8 years of age. His father retired from Texas Pipe Line Company after 30 years of service. Both his father and mother are still living.

Foley is an active member of several professional societies, including AIME and the API.

▸ **V. C. Scott,** division geologist of the Oklahoma division producing department, The Texas Company, has been advanced to assistant division manager. His twenty years service includes such assignments as: Assistant geologist in West Texas division, Ft. Worth, geologist at Tulsa, district geologist at Mattoon, Illinois, and division geologist.

L. H. Lukert, senior geologist, Tulsa succeeded Scott as division geologist. He was employed by The Texas Company as assistant paleontologist at Tulsa in 1934, named junior geologist in 1935, and advanced to senior geologist ten years later.

Harvey Cash of Houston has been promoted to assistant to division manager, Oklahoma division producing department, and transferred to Tulsa. A petroleum engineer with the South Texas division for the past year, Cash joined the company 15 years ago. He graduated from Texas A&M College with a B.S. degree in electrical engineering in 1933.

James F. Neill of Midland, Texas has been promoted to assistant to division manager, West Texas division producing department. Starting with the company in 1935 as a roustabout, he was advanced to junior petroleum engineer at Crane three years later. In 1941 he went on military leave for more than four years. In 1946 he returned as drilling foreman at Midland, soon being advanced to district superintendent of the West Texas-New Mexico district. His new headquarters will be at Ft. Worth.

Edward L. Zihlman, formerly district land man at Wichita Falls, Texas, has been promoted to assistant division land and leaseman at Ft. Worth, West Texas division producing department.

▸ **E. R. "Ed" Koberg,** Baton Rouge sales engineer for Byron Jackson Company, Oil Tool Division, has recently been promoted to the company's Mid-Continent headquarters at Houston. Koberg, who has been at Baton Rouge with BJ for the past five years, was replaced by **D. M. Mundinger.**

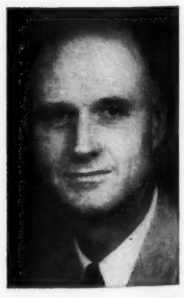
▸ **A. F. Barrett** has been advanced to manager of Rocky Mountain operations, General Petroleum Corporation, at Casper, Wyoming. He joined General Petroleum as geologist in June 1935 at Casper, became senior geologist in 1941 and assistant manager of Rocky Mountain operations in May, 1948.

C. C. Gandaubert became superintendent, Southern Division for General Petroleum, at Long Beach. He joined the company in 1920 as a roustabout in Ventura, became a driller in 1924 and worked throughout most of San Joaquin Valley and Southern California in this capacity. He became a drilling foreman in 1937 and assistant superintendent of Southern Division production in 1947.

O. M. Jensen has been promoted to foreman at Belridge, California. He joined General Petroleum as a head well puller in 1920 and has served continuously in the Lost Hills area of San Joaquin Valley since that time. He became a production foreman "B" for both Lost Hills and Belridge in 1945 and will now be chief production foreman at Belridge.

▸ **Paul Thompson** and **Jim Sayers** have been promoted to division managers for the H. C. Smith Oil Tool Company. Thompson, as division manager of Southern Oklahoma, will make his headquarters at Duncan, and will cover the Golden Trend Area. He has been with the company for the past 10 years and previously was manager of the northern Oklahoma division.

Paul Thompson



Jim Sayers

Sayers has been appointed division manager of northern Oklahoma with headquarters at Oklahoma City. Sayers joined the company in 1940. After service in World War II, he returned to the company last year.

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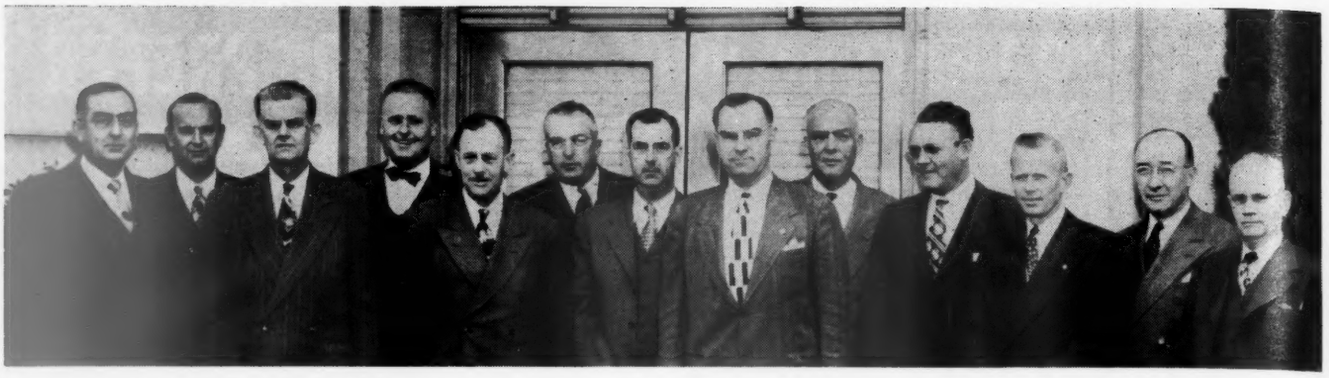

Los Angeles Meeting of Lane-Wells Men

Lane-Wells executives met at the company's home office in Los Angeles, January 10-15, to discuss the technical service needs of the oil industry in 1949. Shown following a day of conferring are, left to right: M. T. Higgs, manager of field operations; W. S. Keim, manager of industrial relations; C. F. Ludwig, Gulf Coast division sales manager; J. D. Hughes, sales manager; J. W. McPhee, Pacific Coast division manager; R. S. Durkee, president; R. B. Downing, Mid-Continent division manager; Ray Hancock, Pacific Coast division assistant manager; D. S. Jeppson, vice president and controller; J. J. Neale, Gulf Coast division manager; C. L. Kirkman, Mid-Continent division sales manager; N. L. Dorn, vice president and chief engineer; E. A. Miller, works manager.

▸ **Charles A. Canfield,** who had been Texas-Louisiana Gulf Coast division geologist for Stanolind Oil and Gas Company, was transferred to the Central division headquarters at Oklahoma City, where he became senior geologist on special regional geological assignments.

Russell A. Weingartner, the new division geologist, came to Houston from the Tulsa general office where he had been a senior geologist doing geophysical coordination work.

M. M. Montgomery is now district production superintendent at Corpus Christi, Texas, for Stanolind. He had been an assistant operating superintendent in the producing department in Tulsa.

▸ **L. F. Peterson, J. G. McMillian,** and **W. Dave Henderson** have organized a petroleum engineering consulting firm known as Henderson, McMillian, and Peterson. Offices are in the First National Bank Building of Midland, Texas.

▸ **Hearn J. Paschall** is now the exclusive representative for the H. C. Smith Oil Tool Company throughout South America, it was announced by Ronald C. Smith, general sales manager. The appointment is effective January 1, 1949. Paschall will make his headquarters in Caracas, Venezuela. He has been associated with the H. C. Smith Oil Tool Company for the past 11 years and during the past year was the company's division manager for Mississippi.

Hearn J. Paschall

▸ **H. Durst,** district petroleum engineer for Humble Oil and Refining Company at Grand Isle, Louisiana division, was promoted to assistant superintendent in the Bayou Sale district. He replaced **R. H. Ussery,** who was promoted to district superintendent at Grand Isle. **V. O. Harris,** former Grand Isle superintendent, went to the Lovell Lake district, from where **R. K. Tracy** was transferred to Galveston Bay district.

W. T. Dabbs, superintendent of the Bayou Sale district, has been transfered to the newly-established Colorado City district in West Texas as district superintendent. **W. S. Bradley,** superintendent of Conroe district, reached normal retirement age.

J. S. Hacker, district civil engineer in charge of construction of additions to East Texas gasoline plants, has been transferred to the Pickton gasoline plant construction district.

J. H. Sorrells is new superintendent of the Tomoconnor gas plant. He replaces **M. A. Mills,** who was transfered to the East Texas gas plants.

William C. Klett, senior civil engineer in Southwest Texas, was transferred to Flour Bluff gas plant district as district civil engineer.

J. L. Lamberson, petroleum engineer, Gulf Coast division office, has been transferred to the Sugar Land district as district petroleum engineer.

Four Humble tool pushers have been transferred. They are: **J. O. Coburn,** from Anahuac to Galveston Bay district; **L. E. Taylor,** from Conroe to Livingston; **E. W. Smith,** from Avery Island to Bayou des Glaise; and **J. B. Padon,** from Avery Island to Grand Isle.

McIver Hay, rotary driller at Grand Isle, was promoted to tool pusher in the Bayou Sale district.

▸ **George B. Coale** has been named assistant general manager of National Lead Company's Baroid Sales Division, effective February 15. His company career began in April 1935, when he was appointed chief engineer of the Sayreville factory power plant. After two years he became mechanical superintendent at the plant, and then spent five years in Navy service. He returned to National Lead in 1945 as assistant chief engineer, and was named chief engineer of the company on January 1, 1949.

▸ **John D. Nicholson,** who has been recently associated with Kennecott Copper Corporation and with Standard Oil of Indiana in its Sugar Creek refinery, and who prior to the war was with Humble Oil and Refining Company at Baytown, Texas, has joined the staff of sales engineers of Southern Engine and Pump Company, Houston, Texas.

▸ **H. F. Schlittler,** a well known oil tool manufacturing executive, has been named vice president of MacClatchie Manufacturing Company, manufacturers of pump liners, pump valves, pump pistons, piston rods, and other specialized production and drilling equipment, according to an announcement by J. Warren MacClatchie, president. Schlittler comes to his new post with a broad background of 19 years executive experience with leading oil tool manufacturing companies. He will make his headquarters in the company's Compton, California plant.

H. F. Schlittler

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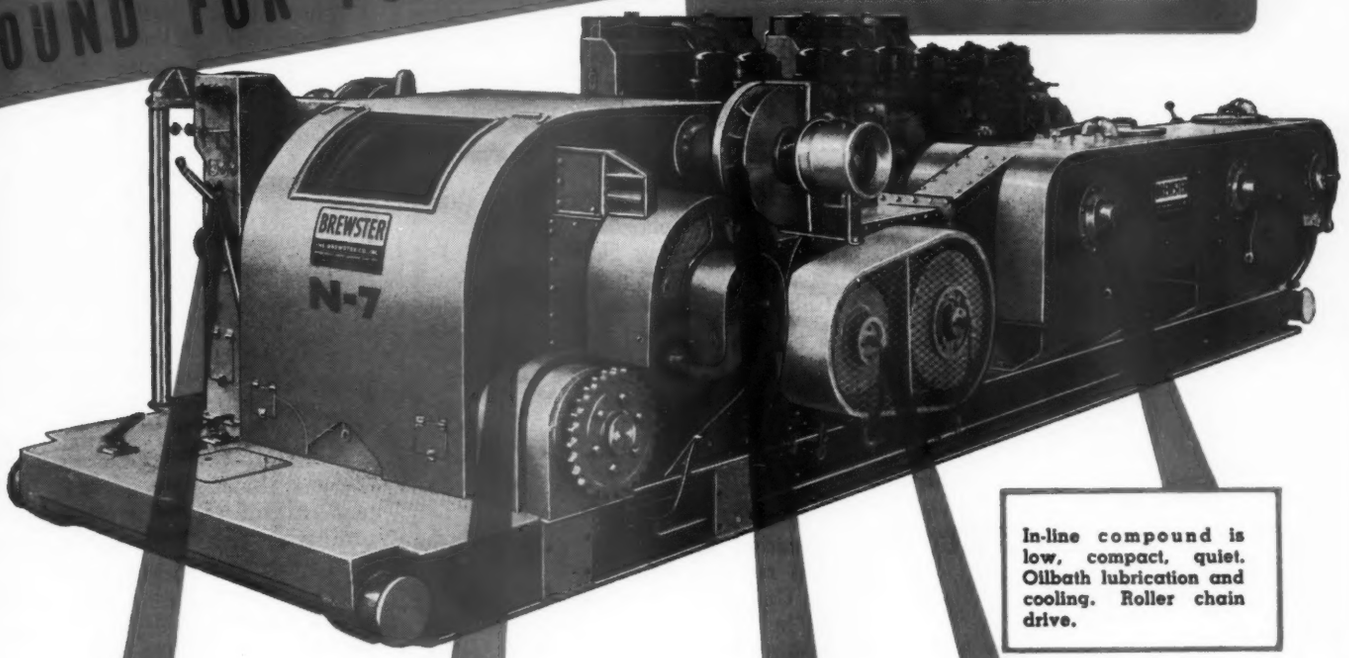

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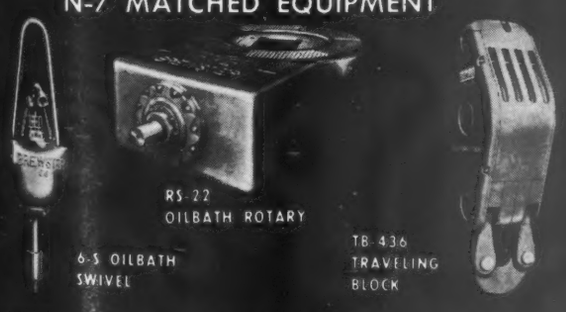

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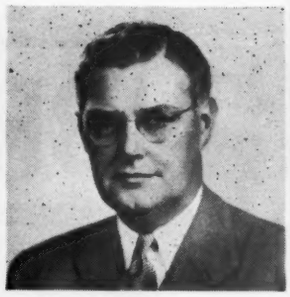
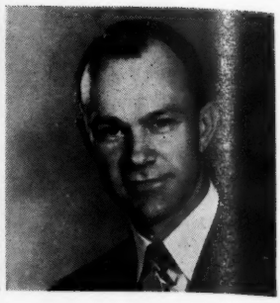


P. E. Lakin

M. G. Edwards



Leo G. Newfarmer

▸ **P. E. Lakin,** new head of Pacific Coast activities for Shell Oil Company, has taken over his duties with headquarters in San Francisco. (*Petroleum Engineer,* January 1949).

Guy Edwards, exploration manager for Shell Oil Company, Inc. on the Pacific Coast, retired January 1, 1949 after nearly twenty-five years of service with the company.

Edwards graduated from the University of Wisconsin in 1912 with a degree in mining geology, later obtaining his Ph.D. at the University of California. He started with Shell in 1924 and has been closely associated with the company during a most vital period of its growth. In 1941 he was made manager of the geological department, and in 1944 was appointed to the position held at time of retirement.

Leo R. Newfarmer, formerly exploration manager in the Houston area replaced Edwards. He attended the University of California, graduating in 1933 with a degree in economic geology. His career with Shell began in 1936 as an assistant geologist in San Antonio, and in 1946 he was promoted to exploration manager, Houston.

▸ **R. B. Sale** has been promoted to assistant region manager of Continental Oil Company's Ponca City production region, which includes Oklahoma, Kansas, Illinois, and Indiana. A native of Denison, Texas, Sale attended Oklahoma A. & M. College and joined Continental Oil Company as a clerk at Ponca City in 1926. After successive promotions he became assistant to the region manager in 1943.

▸ **S. W. "Sandy" Collins,** formerly West Texas district manager for the Hinderliter Tool Company, has joined the International Derrick and Equipment Company to become New York division sales manager. Collins has been in oil well equipment sales for the past 20 years working with Oil Well Supply, American Chain and Cable Company, and Bethlehem Supply Company. He will work with A. L. Woracek and B. V. Brown, who are now in Ideco's New York Office.

▸ **Fred W. Duemler** has been appointed district manager with headquarters in Dallas, Texas, for Stainless Products, Inc., Elizabeth, New Jersey.

Duemler is well known in the petroleum industry because of his many years of association with Walworth Company.

▸ **T. S. (Ted) Green,** new chief geophysicist for Sunray Oil Corporation, will be in charge of the company's expanded geophysical work. He was previously associated with Seismograph Service Corporation, Engineering Laboratories, Inc., and for the past three years he has been with Republic Exploration Company handling geophysical work in Southwest Texas for Sunray.

John M. Schoeppel, as assistant to Sunray's land department superintendent Louis Roark, will aid in coordinating the work of the district landmen in Louisiana, Texas, Oklahoma, Kansas, California, and the Rocky Mountain States. During the past ten years he has been associated with Stephens Petroleum Company, for six years as head of their accounting department and the last four years head of the land department.

▸ **R. E. Whinrey,** who had been superintendent since 1940, has been appointed to the newly created position of assistant general manager of Link-Belt Company's Dodge plant in Indianapolis. **L. C. Heinlein,** formerly assistant superintendent, has been appointed superintendent of this plant, which is devoted to the manufacture of Link-Belt ball and roller bearings of both mounted and unmounted types.

R. E. Whinrey

L. C. Heinlein

▸ **Max B. Campbell,** former special representative in charge of the Dallas office for Hughes Tool Company, has been made division manager of the West Texas-New Mexico division, with headquarters in Midland, Texas. Campbell, a graduate of Rice Institute, has been employed by Hughes Tool Company since 1938 in several operating areas except when on military leave of absence as an officer in the United States Navy.

Charles B. (Chuck) Caldwell, former special representative in Okla-

M. B. Campbell *C. B. Caldwell*

homa City, has been promoted to special representative in charge of the Dallas office. Caldwell studied mechanical engineering at Rice Institute. His oil field experience began in 1935 and he has been employed by Hughes Tool Company since 1937.

▸ **E. G. "Ty" Dahlgren,** assistant secretary of the Interstate Oil Compact Commission, resigned recently to become an oil and gas consultant with offices in the Braniff building at Oklahoma City. In 1942 he became technical secretary of the research and coordinating committee of the Interstate

E. G. Dahlgren

Oil Compact Commission at Oklahoma City. Subsequently, he was made assistant secretary in charge of technical activities. He has been active in various petroleum organizations, and is now serving as chairman of the production review committee of the petroleum division, AIME.

▸ **E. L. Klingler** is now directing the sale of Wickwire rope in the Mid-Continent area with his headquarters at Houston, Texas. He has a background of 19 years in the wire rope industry including production, engineering, and sales.

▸ **Ray Miller** has been made chief hydraulic engineer for The Hydra-Line Division of Johnston Enterprises. His background includes ten years with Vickers, Inc., as chief of the control design group, and service with Bendix where he directed the development of precise aircraft hydraulic controls during the war.

▸ **J. E. Catlin** has been appointed chief petroleum engineer for Lion Oil Company. Other promotions included the appointment of **Frank Zimmerman,** reservoir and economics engineer; **R. I. Williams,** division superintendent for Arkansas, Louisiana, Mississippi, and South Texas; and **John Ragsdale,** production engineer, Kansas division.

Warren Haun, petroleum engineer for Lion, has been granted a temporary leave of absence to serve as petroleum engineer for Guasare Oil Company in western Venezuela. Lion Oil Company owns a one-third interest in Guasare Oil Company.

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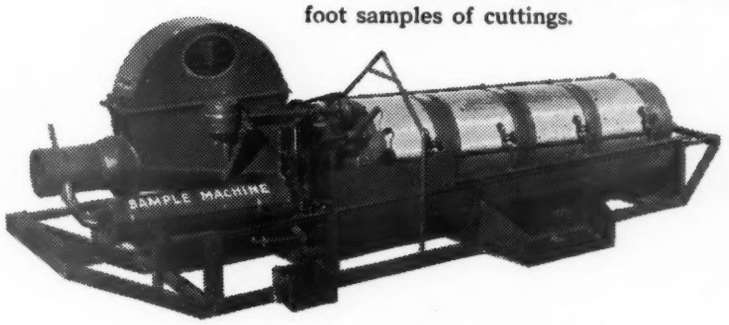

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EXPLORATION ACTIVITIES

Lion Oil Discoveries

Lion Oil Company's Story No. 1 in southeast Columbia County, Arkansas, has been completed in the Smackover lime formation at about 8430 ft. During the first hour test it flowed 45 bbl through a 30/64-in. choke with 600 psi flowing pressure. The well was pinched back to a ¼-in. choke and flowed at the rate of 30 bbl per hour with a flowing pressure of 850 psi. Gas oil ratio is approximately 1000 cu ft of gas per bbl of oil. The well is flowing clean 44 gravity oil with no water. A temporary production allowable for the well of 200 bbl per day has been granted. The name Pine Tree Field was given to the new producing area, and a well offsetting the discovery to the west will be drilled.

The Arkansas discovery follows closely Lion's wildcat McLaughlin completion in Scurry County, Texas, which on initial test flowed at 154 bbl per hour from the Pennsylvanian formation at a total depth of 6617 ft. The discovery well was located on a 5400-acre block leased by the company, and offset wells to the north and south are planned.

Sohio in Guatemala

Standard Oil Company of Ohio announced that contract negotiations are being conducted with the government of Guatemala for oil exploratory rights.

Sohio said it has been conducting preliminary geophysical examinations in Guatemala since 1947, and when the contract with the government has been ratified it expects to do exploratory drilling within an area of about 2,000,000 acres. Production operations, however, should oil be discovered, would be limited to a much smaller area.

Promising Egyptian Field

Socony-Vacuum Oil Company, Inc., has completed the fifth well in the El Asl field of the Sinai Peninsula, Egypt. Early tests were so favorable that Egyptian Government officials predicted a 35,000 bbl daily production rate. Company engineers have not, however, made claims for the well as optimistic as those of the Government.

The Asl area is about 10 miles south of the Sudr field. Both areas are leased jointly by Anglo-Egyptian Oilfields, Ltd., (Shell affiliate) and Socony-Vacuum. Should the area prove highly productive, it will have great significance in military planning.

***Incoming officers** for the Dallas Geological Society are, left to right: Gilbert P. Moore, secretary-treasurer, independent geologist; John T. Rouse, president, Magnolia Petroleum Company; H. V. Tygrett, vice president, Atlantic Refining Company; R. A. Stehr, executive committeeman and retiring president, Seaboard Oil Company; Edgar Kraus, executive committeeman, Atlantic Refining.*

Potential Gas Areas Charted

The U. S. Geological Survey has published a new chart that gives the results of a recent study of the upper Ordovician and lower and middle Silurian rocks in the Michigan basin, Director W. E. Wrather has announced.

The discovery of gas in rocks of middle Silurian age in the Howell field, Livingston county, Michigan, has aroused interest in the possibility of commercial production from rocks of this age in other areas in the Michigan basin.

Major Oklahoma Discovery

Mid-Continent Petroleum Corporation and Viersen and Cochran No. 1 Vollmer CNE NE 1-25-5w, important oil pool opener in Grant county, on test flowed 40 bbl of oil an hr through ⅜-in. choke for 8 hr and then averaged 51 bbl per hr through ½-in. choke for 4 hr. Production is from the First Wilcox sand topped at 5817 ft, and total depth is 5848 ft.

New Field in South Texas

Sunray Oil Corporation has announced a new oil field in South Texas. The field is three miles east of the large Rincon oil field of eastern Starr County and two miles southwest of the El Panal gas field, a Sunray discovery of June, 1948. The field name "Barosa" was taken from the Barosa pasture of the large D. D. Davenport ranch, eastern Starr County.

This new discovery was prefaced by seismic surveys and subsurface studies completed many years ago. Importance of the new discovery is indicated by the multiplicity of producing sands that have been proven.

The discovery well was drilled jointly by Sunray and W. B. Osborn on the jointly-held Davenport-State 320-acre lease, Survey 280, Starr County, Texas, and was completed in September, 1948, for 144 bbl per day through 10/64-in. choke from a sand at a depth of 4300 ft.

Sunray has approximately 1890 acres of leases in a contiguous block comprising the area of the Barosa field and the El Panal gas field northeastward. In the Barosa field Sunray has half interest in 320 acres and full interest in 1000 acres that will be affected by the new discovery. There are now five producing wells in the field and Sunray has two additional wells drilling.

Three producing sands of the Frio formation have been discovered in this new field. These are at varying depths of 4300 ft, 4500 ft, and 4750 ft, referred to as sands "C," "D," and "E," being correlative to similar producing sands in the Rincon field.

Exploration Superintendents

Stanolind Oil and Gas Company has created the position of division exploration superintendent in its Canadian and Colombian divisions. Announcement was made by C. T. Jones, manager of Stanolind's foreign exploration department.

Named to the new posts were G. T. Buskirk, formerly division geologist at Bogota, Colombia, and C. F. Schock, formerly division landman at Calgary, Alberta, Canada. Each will remain in charge of the Stanolind office at his location.

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Otis Removable Tubing Safety Valves consist of a simple pressure-differentially-operated type valve mechanism, equipped with a flow bean of desired size, and made up with one of three different types of lock-and-pack-off assemblies (depending upon specific well conditions). Each type is easy to run, set, service, and pull under pressure on a steel measuring line. Under normal producing conditions the valve is held open by a coiled spring. Flow course through the tool follows a single straight bore. Sealing surfaces of the valve and valve seat are out of direct line of flow, thus safeguarding critical parts against flow cutting. However, the instant surface connections fail to the extent that the upward thrust of the pressure differential across the flow bean exceeds that of the compression in the spring, the valve automatically snaps to a positive shut-off. After surface repairs have been made the tool can then be re-opened by equalizing pressures across it.

Don't wait until storm warnings go up! If you are operating wells located in vulnerable areas, begin your safety program *today* with a call to the Otis man nearest you. He is well equipped to give you a detailed description of how Otis Removable Tubing Safety Valves can provide you with dependable "storm cellar" protection.

The Type F Otis Removable Tubing Safety Valve Cage Assembly (shown in red) can be made up with one of three different types of lock-and-pack-off devices: (1) the Type J Mandrel Assembly (shown on left) which seats and locks in a Type J Otis Landing Nipple and Flow Coupling installed in the tubing immediately above the packer; (2) the new Type S Otis Mandrel Assembly (recommended for use under extreme temperature, pressure, and corrosive conditions) which seats in one of several Type S Otis Landing Nipples installed at desired depths, thus permitting the simultaneous use of Otis Removable Bottom-Hole Regulators and Chokes in the same string of tubing; or the Type B Mandrel Assembly, recommended for use under temperatures up to 180° F in wells which have not been equipped with new Type S Otis Landing Nipples.

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Venezuelan Discovery Well

Phillips Oil Company, a wholly owned subsidiary of Phillips Petroleum Company, has completed an outstanding new discovery well on its 130,000-acre concession in the State of Anzoategui, Venezuela, near the Toco, Santa Ana, San Joaquin, and Roble oil fields, according to K. S. Adams, president of both companies. This well found several oil saturated sands, having a total thickness of 165 net ft in the Colorado section of the Oficina formation between the depths of 7740 ft and 8500 ft.

On production test the top zone flowed 40 gravity oil at the rate of 1500 bbl per day on 3/8-in. choke through 15 ft of perforations. The three successively lower zones produced on test at the respective rates of about 500, 300, and 500 bbl per day, all on small chokes and with gravities of oil ranging from 41 to 45 deg. It is planed to make a dual zone completion of this well in the top two sands.

There are two pipe lines in the vicinity that transport oil to the coast, and arrangements for an outlet are now under way.

The company has recently sent additional drilling equipment to Venezuela to augment the development of this field. The new discovery is approximately 70 miles west of the Mata Grande Pool where the company discovered its first Venezuelan oil in 1946.

New Companies Added

The Geotechnical Corporation, Dallas, Texas, headed by Roland F. Beers, has recently announced the addition of two new companies to its organization. The activities of the two new companies are being coordinated with those of other companies in the Geotechnical organization under the supervision of William B. Heroy, Sr., executive vice president.

Effective October 1, 1948, the Geotechnical organization assumed the interests of the Walters Drilling Company of Dallas. The field operations and drilling undertakings of that firm have been acquired by a new organization, Geotechnical Drilling Company. This company will specialize in short-hole and core drilling. Its president is C. G. Walters.

The Geotechnical Corporation acquired control of Garrett Exploration Company and affiliated interests November 1, 1948. The seismic surveys and geophysical operations conducted by the Garrett organization will hereinafter be entrusted to a successor corporation, the Geotechnical Exploration Corporation, with Maynard P. Jones as president.

Shell Expands in Louisiana

Further expansion of Shell's activities in Louisiana has been announced by Ernest G. Robinson, New Orleans area manager. A new district land office was created at Lake Charles the first of the year. J. (Jack) D. Hunnicutt, former district land agent at Tallahassee, Florida, has been appointed district land agent and will be in charge of land and title work in the South Louisiana territory lying generally west of the Atchafalaya River. A number of senior landmen and other employes will be transferred from other districts to fill the personnel complement at Lake Charles. Addition of a land office to the exploration and production offices already established at Lake Charles gives Shell a completely integrated coverage of these major functions in that territory.

J. D. Hunnicutt *P. S. McClure*

On February 1, 1949, a new district exploration office was established in Baton Rouge. Perry S. McClure, former district geologist at Denver, Colorado, becomes the district geologist at Baton Rouge and will be in charge of exploration activities of the company for Southeastern Louisiana, comprising that part of the state lying generally east of the Atchafalaya River. A new office is being constructed to house the new exploration office as well as the present Baton Rouge district land office, headed by E. C. Abell.

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THIS EXTRA SAFETY FACTOR is just one of the advantages of BJ *Speed-Trip* Power Slips. These Power Slips can be installed during drilling operations. They are the only Power Slips that can be swung 180 degrees away from the rotary thus giving maximum working room. BJ Power Slips have a double-acting pressure cylinder and a guide cylinder . . . You get pressure-raising and pressure-setting. Gravity lowering is slow and unbalanced. BJ Power Slips are the first pressure-lowered Slips. *Speed-Trip* Slips give you pressure-centering, uniform setting even when the pipe is not centered! FOR COMPLETE INFORMATION—write for the new BJ *Speed-Trip* Power Slips Bulletin.

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What's Doing in DRILLING

Drilling Classes Begun

Kern County Union High School District Board of Trustees, Bakersfield, California, recently approved an expanded oil industry adult educational program planned and developed by the local Oil Industry Educational Advisory Committee.

The program is offered by the Bakersfield evening high school under the direction of Guy W. Garrard, principal, and John Van Osdel, coordinator of the oil industry classes.

In addition to the sixth 30-hour oil mud control class, classes in drilling and production were scheduled.

Topics offered in the Drilling Practice class include: drilling engines, mud pumps, draw works, rotary tables, drilling string, lubrication of rig, drilling bits, fishing tools, special services, wire lines-chain-rope, rigging up and dismantling, reports, measuring, cementing, completion of wells, standard production practice, how an oil field is developed, safety practices, relations of drilling contractors to oil companies, insurance coverage of employes, strength of materials, simple hydraulics, mechanics and structures, piping, hose, valves and fittings, hand tools, layout, and miscellaneous subjects.

Production Practices class affords the following topics: oil well completions, flowing wells, pumping wells, underground pumping equipment and pumping problems, reconditioning wells, mechanical failures, repressuring fields, gathering, gaging, and shipping crude oil, and treating.

Ward Klink of the Ohio Oil Company and E. L. Mohr of Baroid Sales Division are instructors for Oil Mud Control; and W. F. Jones, former secretary of the American Association of Oil Well Drilling Contractors, California Branch, and now vice president of Stansbury, Inc., instructs in drilling practices and production.

Bonus by Drilling Company

A year end bonus was distributed to all drilling foremen and office personnel based on 10 per cent of 1948 salary plus 1 per cent for each year employed by the San Joaquin Drilling Company and San Joaquin Drilling Company, Inc.

All hourly employes who had been continuously employed by San Joaquin Drilling Company for a period of at least one year also received a bonus afterwards based on pay.

Foreign Tour

W. H. Siems, export sales manager of Hughes Tool Company has recently returned to his headquarters in New York City after a three month's tour of the oil centers in Europe and the Middle East. Following initial conferences with British operators, Siems visited Scandinavian operations in Sweden and Denmark. After visiting Turkish oil operations, he included both France and Italy on his touring agenda, thence returning through the Middle East oil field areas of Iraq, Iran, Kuwait, and Algiers.

The completed trip afforded the management first-hand information on current drilling practices, supply requirements, and other vital data on the export fields visited. R. G. Roberts, European division sales manager for Hughes Tool Company with headquarters in London, accompanied Siems on the extensive trip.

Power Rigs Described

The place of the drilling contractor in the petroleum industry is indicated by a pamphlet in color issued recently by Rocky Mountain Drilling Company of California. This release gives full specifications covering fifteen power rigs, capable of handling any drilling job up to 15,000 ft, with particular details on drawworks, mast, main pump, standby pump, and power plant. Rocky Mountain company uses nothing but power rigs, with a diversity of power output ranging from 770 hp to 1950 hp.

AAODC Directors Meet

Directors of American Association of Oilwell Drilling Contractors have announced that their ninth annual meeting in October will be held in Dallas. The directors selected this city during a quarterly meeting held in Dallas January 18. Joseph S. Morris, Association president, said dates of the meeting would be announced as soon as hotel arrangements are made.

The thirty-five directors attending the meeting heard a report that an average of twenty-seven industry men in each of fifteen oil centers had registered for a series of management institutes the Association sponsors.

In reporting on the institutes, C. J. Paine, F. B. Paine Drilling Company, told directors each of the fifteen conference centers had over-subscribed the minimum of twenty enrollees. Paine is chairman of the Association's Educational and Administrative Committee. He also reported that 4500 men have now completed mud control schools conducted in eleven oil producing states.

An employment unit plan for drilling contractors was outlined by John Woodruff, co-ordinator of petroleum training, University of Texas. The plan enables contractors to offer their supervisory personnel a training service on management problems. Woodruff said the project would be financed by subscription of individual firms, underwriters, and state funds. One unit will begin operation in West Texas in February, he said.

Presentation of certificates shows W. F. Jones; John Van Osdel; Ward Klink, Ohio Oil Company, instructor, presenting an AAODC certificate to Charles L. Glazner of Loffland Brothers; Guy W. Garrard, director of adult education, Kern County Union high school district, waiting to present a Bakersfield evening high school certificate of completion.

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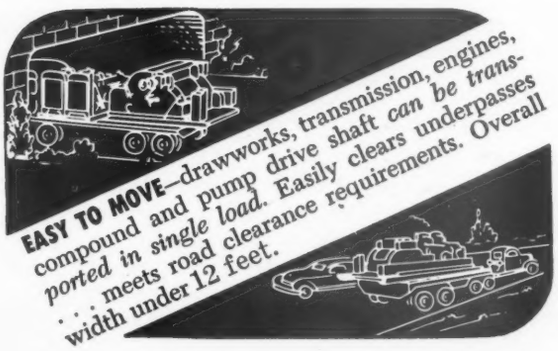
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Tri-State ODC Leaders

The Tri-State chapter of American Association of Oilwell Drilling Contractors has elected Ira Van Tuyl, V-T Drilling Company, Evansville, Indiana, chairman for the coming year. Kenneth Lindskog was elected vice chairman of the Illinois, Kentucky, Indiana group, and Edward Wick was named as a full time secretary, succeeding Earl Jukes, resigned.

Safety Committee Active

Plans for the fourth annual drilling industry safety clinic, scheduled in Dallas May 24-25, were made at a meeting of the Insurance and Safety Committee, AAODC, January 17. Dorris Ballew, committee chairman and an Association director, said one clinic session would be devoted to a tool pusher conference, and another to safety measures in operating trucking units. Presentation of papers and reports from special work committees will complete the two-day program.

The committee held a special meeting February 3-4 in New Orleans to study safety of water operations. This meeting, open to all interested in this type work, resulted from requests from both drilling contractors and major producing companies.

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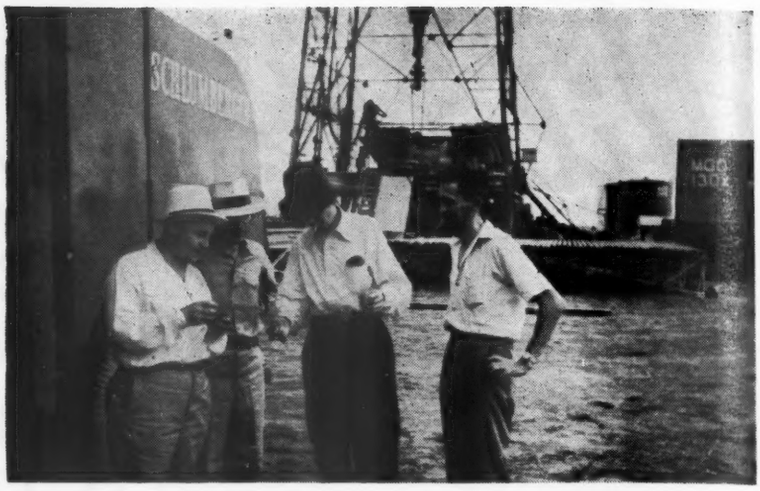


Near El Tigre, Venezuela, *M. Schlumberger, co-founder of Schlumberger Well Surveying Corporation, made a first-hand field inspection of one of the new Schlumberger units operating in Eastern Venezuela oilfields. Left to right: W. J. Gillingham, manager of Schlumberger Surenco; J. De Menil, president of Schlumberger Overseas; M. Schlumberger, and L. A. Allaud, chief engineer in El Tigre.*

Los Angeles Contractors

The Los Angeles chapter of AAODC met at Scully's restaurant on January 13, and with Ed Simonis doing his first stint in the chair, and Lee Daniel also standing by for his initial performance, many matters of interest to the organization were discussed. Among the topics were taxes on gas for stationary gas engines, dues, standardization of contract bidding, cost accounting, safety, and vocational training. The sponsors of these various debates, not necessarily in the order named, were Curly Stansbury, Frank Jones, Doc Hayes, Karl Kellogg, San Williams, Doug Graham, Art Heiser. During the evening, it was announced that the executive committee would consist of the following: K. L. Kellogg, chairman; E. C. Brown, Ralph Marshall, Tom Pike, Jr., and A. S. Hayes.

Following the airing of all local business problems, the meeting was turned over to John Woodruff of University of Texas, who outlined what has already been done by the University, in cooperation with the contractors' association, in a national program of education in the drilling industry. Woodruff offered aid in the formulation and conduct of a symposium to be especially designed to the needs of the California industry, as determined by the local chapter officers. His program of six major studies to be selected and approved by the local chapter, after discussion with Ned Brown, research and education chairman, was well received. In fact, before the meeting closed, enough enrollments had been received to guarantee the success of the project.

Sequel on Rocky Jerman

Rocky Jerman's test of the Long Beach De Soto sand, Victory No. 1, is now producing 461 bbl of 29 gravity oil with a 4 per cent cut, through a ½-in. choke. It is not exactly a world beater but is sufficiently successful at least to stimulate further deep tries. A location has been staked at the corner of 32nd Street and Pasadena Avenue by Hancock Oil Company; and Warren Meeker is planning another at the corner of 31st Street and Linden. Victory No. 1 was completed at 10,429 ft, the De Soto sand being topped at 9730 ft. *The Petroleum Engineer* of November 1948 carried a complete story on the progress of this well.

Houston ODC Officers

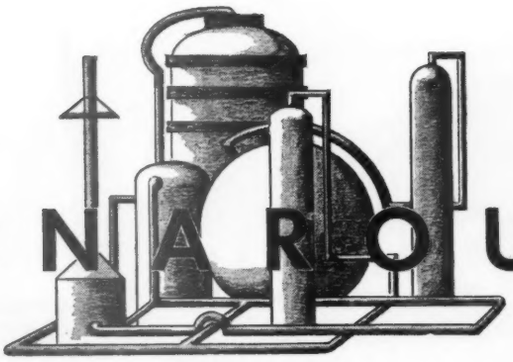
W. Gilbert Prince, president, Prince Drilling Company, Inc., has been elected chairman of the Houston chapter of American Association of Oilwell Drilling Contractors.

Rex Parks, Loffland Brothers Company, was named vice chairman of the group, and G. G. Orr, Harry L. Edwards Drilling Company, was elected secretary.

Drilling Mud Schools

Mud schools were held in January at the Sun Oil camp, Premont, Texas, and in early February at Alice, Texas. Jim Conway, University of Texas, was the instructor. The 25-hr courses, open to all workers in the drilling industry, covered such subjects as mud tests and analyses, good mud practices, and use of chemicals, gels, and weighting materials in controlling mud quality.

THE TURNAROUND



MORE MILES PER GALLON, INDUSTRY'S GOAL

PROBABLY the outstanding achievement in cooperative technical development of all time is that carried out during the last third of a century between the oil and automotive industries. Why be concerned that each industry recurrently passes the buck for the removal of bottlenecks to the other industry, which as insistently hands it back to the first giver?

Doubly interesting, therefore, is the remarkable similarity between the principles enunciated recently by three leaders in this field, speaking separately and from different sides of the common problem, but agreeing perfectly on the one major requirement of and for all concerned. That requirement is, greater efficiency in the conversion of fuels to power production, in all phases of the development of the country and the world. On that theme hangs "All the Law and the Profits."

We must improve the overall efficiency of our automotive power plants, now about six per cent, said W. M. Holaday, research director for the far-flung Socony-Vacuum Oil empire, in a talk prepared for a West Coast SAE meeting. The motorist's desire for performance and comfort is the 'quotient' of this poor efficiency, says Holaday; use of high compression engines and fully automatic power transmissions are only two of the means by which fuel mileage may be doubled. U. S. heat requirements now are a billion Btu per second continuously, more than half of which is derived from petroleum. Requirements are increasing at the rate of a trillion—1000 billion —Btu per annum.

Dr. W. S. James, is even more specific in his statements of fact and in his recommendations. Raising thermal efficiency to a practical 40 per cent will raise engine efficiency to 33 miles per gallon, double the present return, James said, talking to the National SAE, of which he is a past-president. Reduction of stops at traffic lights may increase efficiency 10 to 25 per cent. Also, efficiencies may be raised by:

Use of overdrive, 13-20 per cent; supercharging, 17-24 per cent; automatic transmission, 27 to 48 per cent; high compression ratio, smaller engines, 11-25 per cent; reduction of heat loss, etc., 10-40 per cent; more accurate carburetor metering, 5 to 50 per cent; 15 per cent weight reduction, 10-17 per cent; lower wind resistance, 8-9 per cent. Necessarily, these are not all cumulatively and simultaneously effective to these percentages.

Increased fuel efficiency and supplementary fuel supplies can be developed during the slow petroleum depletion process of the next 15-20 years, and thus assure an adequate supply, affirmed SAE president R. J. S. Pigott, Gulf Oil's engineering research director.

Although only one or two of these factors, those of providing suitable fuels for supercharging and for higher compression ratios, fall directly in the lap of the oil refining industry, what a tremendous factor those items are! The maximum utilization of high compression ratios and pressures cannot be attained without manufacturing the maximum practicable anti-knock quality in fuels. As pointed out here and elsewhere, however, a large number of engine improvements can be made by the automotive engineer to increase miles-per-gallon when using present fuels and their current qualities. "The engineers of the automotive industry," says James, "are familiar with all these paths to greater miles per gallon," and will adopt them when overall compromises indicate their desirability.

Synthetic methods for fuel production to augment petroleum supplies are uneconomical so far, Holaday points out but within 10 to 20 years these processes will be reduced in cost by research and development. Meanwhile "other steps can be taken to reduce today's (per mile) demand for liquid fuels."—A.L.F.

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Fluor pulsation dampeners were installed as original equipment on the 1200-mile natural gas line from West Texas to Southern California. This view in a main line station at Tucson, Arizona shows Fluor pulsation dampeners on both the suction and discharge sides of the compressors. These dampeners are paying for themselves by permitting the required gas flow to be maintained with minimum horsepower. **photo by Elwood M. Payne**

Employee Training Program

TRAINING of operating employees reaches a high degree of efficiency in two refineries of the Socony-Vacuum Oil Company, Inc., although the training program in the two places differs in many respects. The refineries are at East St. Louis, Illinois, and East Chicago, Indiana.

Company officials are enthusiastic about both training programs and view each as very successful and productive. Both plans undoubtedly will become models of training programs for other Socony-Vacuum refineries.

The two plans have top employee efficiency and maximum economy in operation as their goals, of course. How they achieve these goals is another matter.

Both plans recognize the need among operators for complete familiarity with their equipment, company objectives in production and other matters, maximum cooperation among individuals, and knowledge of the necessity for gearing today's refinery operations to increasing competition. There the similarity ends.

Probably the older of the two programs is the one at East Chicago, developed during wartime when turnover due to military service presented constantly-recurring problems of properly-trained new refinery personnel. Now its value is found in providing a readily available reservoir of trained employees as positions for them become available.

In concrete measurable results, perhaps the East St. Louis program is outstanding. Here the program has yielded printed standards and procedure manuals which provide specific yardsticks for operation of each of the refinery's units. The result of such standards is stabilization of daily operations and higher efficiency than has been reached previously in this refinery.

The East Chicago program is keyed to a system of a standard curriculum over a period of a week for each new training class, supplemented by demonstrations and motion pictures. The East St. Louis program is of a more continuous nature, the aim being always to improve the standards and to keep the operators apprised of the importance of the standards, and to enlist and assure the assistance of the refinery personnel in improving the standards.

At East Chicago, employees must be high school graduates at least to qualify for a training class. Directors of the training program there feel that basic knowledge of molecules, distillation processes, chemical reactions and such is a good background for candidates for production jobs.

At East St. Louis, a feeling exists that ability and knowledge from on-the-job contact with the equipment, plus training for the specific work to which the employees are assigned, is of most importance.

East Chicago's program, in brief, is based on the theory of "a good and well-trained man" for every job which needs to be filled either permanently or temporarily—a highly-desirable goal in every refinery. East St. Louis' program leans more to the theory of "the best and most-qualified man" in each job. Daily reports from each unit, in the latter case, are compared with the unit's standards to provide constant assurance that this is true.

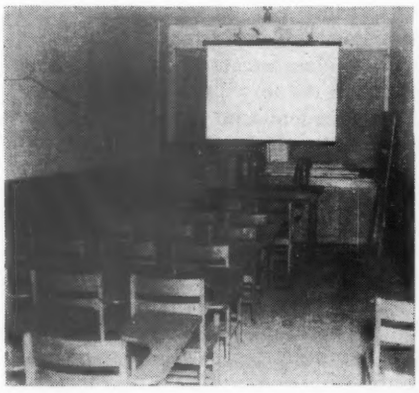
W. W. Reed, superintendent at East Chicago, who points out that his refinery's training program has yielded 220 comparative production experts in the last five years, lists these primary benefits from the program:

1. The trainees have a better knowledge of the fundamentals of the operating jobs and of what is expected of them.
2. Trainees learn their work more readily and require less "on-the-job" instruction.
3. Classes are excellent as refreshers for men returning from military service.
4. Trainees appear to take more interest in their jobs.
5. Trainees are in a position to ask for additional information more intelligently and to understand better the information which they receive.
6. Trained operators are available to fill in at jobs during vacation time and during vacancies which occur during the remainder of the year.
7. Need is eliminated for holding over operators from one shift to another because of a lack of trained men.

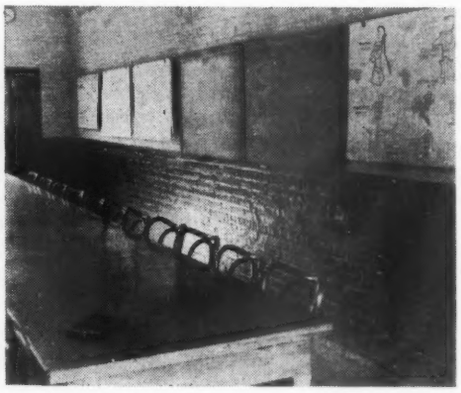
Here employees enter the week-long training program after advancing to the fireman level from lower-grade positions. Each class is limited to 8 or 12 men and the first class, five years ago, utilized only one instructor. Since no training manual was available, this instructor had to rely on notes and his knowledge and experience in refinery operations.

Then the number of instructors was increased gradually to 11 as supervisors from different departments were assigned to each class to present their specialty.

Now each instructor's lecture material, illustrative material and class schedule have been compiled in one



The motion projector is an important implement in training of refinery employes. The picture on the left shows the projection room at East Chicago plant.



Large clear simplified drawings, blackboards, and other teaching aids are provided in this demonstration room at East Chicago, where lectures are given.

Supervises Chicago Employee Training

WILLIAM WALLACE REED, superintendent of the refinery of the Socony-Vacuum Oil Company, Inc., East Chicago, Indiana, is in general charge of the company's employee training program there. He started with the Vacuum Oil Company, Milwaukee, Wisconsin, on May 5, 1922, as a chemist in the marketing department.

A native of Milwaukee, he was educated at the Milwaukee State Teachers College, University of Wisconsin, and University of Indiana. In June of 1926, he was transferred to the East Chicago refinery as a chemist and became assistant superintendent in July of 1932. He was appointed superintendent some years later.

"Master Instructor's Manual" for use by all of the instructors, supplemented by other educational devices such as wall charts to show refinery operations and equipment; cutaways of actual refinery equipment such as valves, pumps, and even a portion of a fractionating unit to show its construction as well as the location and functions of bubble caps and trays. Motion pictures on safety, production, basic hydraulics, fluid flow and similar subjects are utilized also.

Each class's studies are divided between classroom work and field trips within the refinery. The classroom facilities consist of two rooms. One is a conference room used for no other purpose which contains a long table and chairs, blackboard, wall charts, samples of pumps, oil and gas burners, bubble caps, instruments and such refinery items as are small enough to be handled easily.

The adjoining room is furnished with desk-armchairs, a motion picture projector and screen, and a demonstration table. Outside these rooms are some furnace tubes rolled into typical return bend headers and the section of the small fractionating unit with a portion of its wall cut away to show the bubble trays.

The 11 subjects taught in classroom study supplemented by motion pictures and refinery field trips include safety and fire control; distillation and fractionation; typical crude distillation unit; refinery equipment generally; purpose and construction of such equipment as heat exchangers, barometric condensers, cooling towers and the API separator; laboratory tests; pipes and fittings; basic hydraulics; refinery pumps, corrosion and inspection; refinery instruments, and, finally, combustion and operating practices.

On field trips, the trainees observe and participate in lighting an oil burner on one of the heaters, in addition to drawing a sample, drawing water from a tank, using a steam hose, starting a pump, changing charts and bleeding a gauge glass. As part of the instruction on refinery equipment, each trainee receives an ozalid print of various types of equipment to show construction and the names of the various parts. Instruction on laboratory tests emphasizes the significance of such tests as API gravity, Engler distillation, Reid vapor pressure, color, flash and fire, viscosity, pour point, octane number, B. S. & W., and so on. Instruction on pipes and fittings familiarizes the trainees with kinds of pipe, pipe fittings and valves used in the refinery as well as why different types are used in various places.

Definitions and principles of pressure head, quantity of flow, Pascal's law and pressure drop are covered in the class on basic hydraulics, accompanied by the working out on a blackboard of various problems in order that the trainees can participate in solving them.

As at East St. Louis, the trainees at the East Chicago refinery attend the classes on company time at full pay. Each class consumes five days, and the hours are from 8 o'clock in the morning to 4:30 o'clock in the afternoons, with a half-hour recess for lunch and a 10-minute recess in the morning and another in the afternoon.

Supt. Reed said the classes of 8 to 12 trainees at a time has proven most satisfactory because more individual instruction can be concentrated on each man. At the start of each class, they are given a large notebook and are supplied with pencils. Ozalid prints of flow diagrams, refinery equipment and other subjects are added as each class progresses.

Each class starts with a welcome from the refinery's general operating superintendent who explains the purpose of the training, importance of refinery jobs and similar topics, after which the regular schedule of the classes is started.

Instruction in a typical subject—safety and fire control, in this instance—is divided in this manner: Fire control, 50 minutes; rules of oil-fire fighting, five minutes; methods of oil-fire fighting, five minutes; fires in contained oil, 10 minutes; fires in flowing oil, five minutes; liquefied petroleum gas fires, three minutes; extinguishing agents, 15 minutes, and fire-fighting accessories, seven minutes. Of course the chronology for each subject is necessarily flexible but the general pattern is conformed to as closely as possible for maximum benefit to the trainees. Time is devoted later to field trips and demonstrations in connection with the safety and fire control course.

A written examination of the "True and False" type is given at the completion of the training program, lasting usually just 15 minutes or so as an indication of its brevity. The examination papers are not signed by the trainees but they are graded to determine the class average. This examination is principally of benefit to the training program, inasmuch as it discloses the subjects that need to be explained more thoroughly in future classes. Thus flexibility of the program is maintained constantly. The test provides a check, too, on the efficiency and ability of the instructors.

The trainees in each class, as pointed out before, enter the training program on the fireman level and move into refinery positions on this level. Thence they advance to operating and other positions, including testers in the laboratories and to jobs in the water-treating plant.

In setting up the somewhat different training program at the East St. Louis refinery, C. P. Baker, manager, and H. A. Lutz, process engineer, recognized that "the skill required of a process operator to operate the complicated and expensive refinery units is not one commonly available."

In addition they were confronted with the probability of an increase in operating personnel in the near future, due to an expansion and renovation program now under way. And among

Heads E. St. Louis Employee Program

CHARLES P. BAKER, manager of the Socony-Vacuum plant at E. St. Louis, and in general supervisory charge of the employee training program there, is a chemical engineering graduate of Texas A. & M. College. He started in the oil business in 1934 with Magnolia Petroleum Company. In 1936 he went to Houdry Process Corporation and the next year was assigned to the Research and Development Department at Paulsboro; later he returned to Magnolia at Beaumont.

Three years of military service with PAW brought him a major's leaves. He returned to an operator's job at E. St. Louis, Illinois, as assistant to Manager W. H. Montgomery.

all of a refinery's personnel, according to Lutz, the operators "have to be the closest to perfection in performance of their tasks."

Although about 150 men have been exposed to or are still participating in the continuing method of East St. Louis' program since its inception several years ago, and have benefited themselves and the refinery accordingly, one of the principal dividends has been the opportunity it gave the refinery's technical men, who participate in the program, to increase their own knowledge of the plant's workings.

This program concentrates principally at present on stillmen and operators although expansion to firemen is contemplated as soon as the refinery's expansion schedule is completed and more time for instruction is available to instructing personnel.

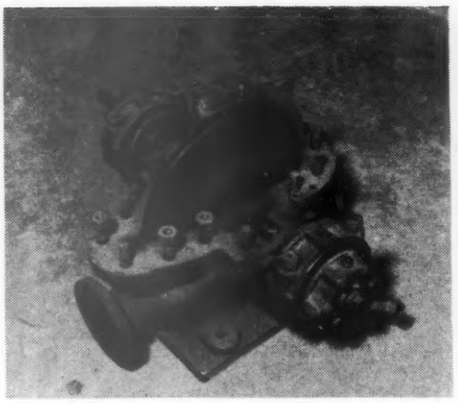
The firemen are exposed indirectly to the training program, however, through their presence in control rooms and the consequent impressions they obtain of the importance of standards, daily operating reports, and the standard operating manual for each unit.

This training program rests on three foundations—the operating standards for each unit, the manuals for individual guidance of the employees, and on periodical meetings which are held as often as the need dictates.

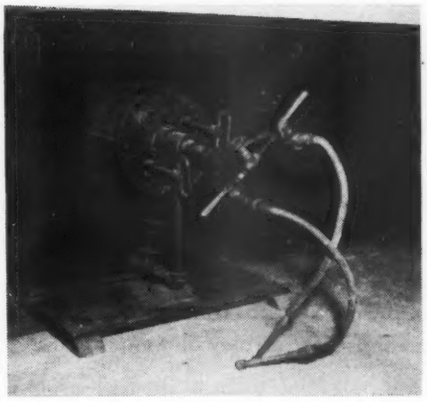
Each meeting is, in effect, a refresher course in itself although emphasis at each is usually on some particular aspect of refinery operation. For this purpose, experts in specific subjects, such as electrical and pump specialists, are featured at successive sessions. The technical personnel attend all such meetings as a regular part of their jobs.

Each meeting is confined, too, to the operators and stillmen for a particular unit and require about two hours each. When it is necessary to do so, such as in cases of men whose regular shifts are over, premium pay is paid for attendance at the meetings.

When an employee is promoted from fireman to stillman or even operator, he is given a personal copy of his own of the operating manual for the unit to which he is assigned. It is an exact duplicate of the one maintained constantly at the unit itself to provide an inflexible day-to-day guide of the unit's operations. The employee is encouraged to study the manual in his spare time at home to acquire as much familiarity with it as possible against the times when he must refer to the unit's manual while at work. He becomes eligible immediately and automatically for attendance at meetings of the unit's personnel.



A 'sample' centrifugal pump, with the upper housing removed, left, is used to show employees how such pumps work, the different parts and their important functions.



The demonstration still burner assembly is used to show the various parts and of handling used in running a refinery. their operation, repair, and methods.

In addition to the benefits from operation of a refinery at maximum efficiency, East St. Louis' training program is geared to a realization also of the losses which can occur because of an operating error which results from lack of knowledge of a specific item of equipment. The simple turning of a valve in the wrong direction, for instance, can endanger many lives and jeopardize an investment of millions of dollars.

Hence training at the East St. Louis refinery is allied closely with actual production. The use of written operating standards to stabilize refinery operations was begun in January, 1946. These standards contained established points of control and descriptions of the methods to be used for maintaining these points, after which copies were issued to all operating personnel.

The complete operating manual is still in the development stage and will contain a brief history of petroleum and refining; a brief history of the Socony-Vacuum Oil Company, Inc., and a full description of each operating unit. This latter portion is considered most important and is essentially complete.

The preparation of the operating standards and manual was assigned to the refinery's technical and engineering division, headed by D. P. Parker. Information for them came from operating, maintenance, laboratory, industrial relations and other divisions of the refinery. Each section, before issuance, was approved by all divisions concerned and the plant manager.

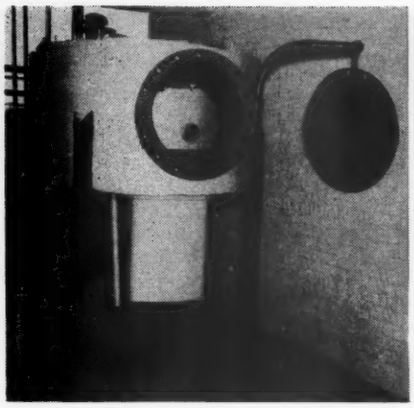
The department manager gave the first set of standards to the process operators of the crude unit for the purpose of determining how the personnel would accept and react to them. Once in use, the minor shortcomings of these standards were noted; and the cooperation of those men responsible for the operations resulted in improvements which are still being made for more efficient operations.

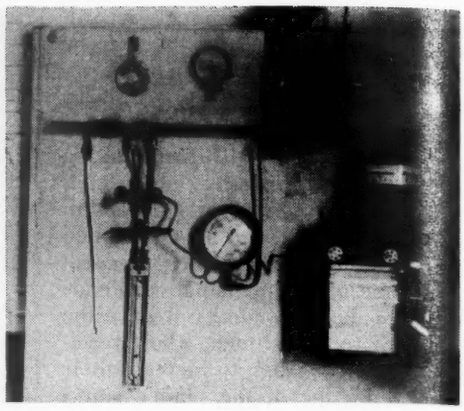
These operating conditions were to be followed during normal operation. It was expected that abnormal conditions could and would arise and that temporarily the unit could not be operated within the limits as specified in the operating standards. As soon as these conditions were corrected, however, it was expected that control of variables would be governed again by the operating standards.

A general description of the crude unit was a part of the operating standards distributed for this unit in 1946. This section consisted of flow diagrams with explanations of the various sources of feed to the unit as well as the disposition of the products. Some practical theory of fractionator operation was included also.

From the crude unit, the training program moved to the other refinery units. A considerable amount of time was spent, especially, in preparation of standards and on an operating manual for the TCC unit. In addition to the general description, the manual for this unit included some theory of catalyst flow—a new principle. Special equipment on the unit, as well as the complicated controls, were discussed in detail. Pump curves, showing the capacity at the various heads and the power required of the prime mover, were incorporated also.

After the operating standards had been issued for a specific unit, a form was prepared. When filled out by that unit, it constitutes a summary of the previous 24 hours' operation. In addition to the control points, these sheets also show an average of other operat-





Part of the training program is general, and part of it specific. Here is a section of bubble tray fractionator, showing important parts and their functions.

Valves, meters, recorders, indicators, and similar equipment used by employes in plant. Several items of equipment arranged for display and explanation.

ing conditions and provide for remarks on the unit's performance.

These summary sheets are filled in each morning about 6 o'clock by the process operator and are forwarded to the Technical and Engineering Division where they are checked for points which are off the standard. Duplicate copies are sent to the Department Manager, Operating Superintendent, Technical and Engineering Division Manager, and to the Refinery Manager.

This method permits a quick evaluation of the unit's previous 24-hour operation and furnishes a continuous history of the operation for ready reference, as well as adding to the training material which is available to assist the operators in becoming more proficient at their jobs.

Giving the operators an opportunity to express opinions as well as to ask questions, and to provide a springboard for additional information, was the next objective in the training schedule and the periodical meetings evolved almost naturally. Firemen and utility men or any other refinery personnel are welcome to attend the meetings on their own time, compared with the overtime paid stillmen and operators for whom the meetings are held principally.

As a rule, two meetings on the same subject are necessary to cover the personnel assigned to a single unit. From 10 to 20 individuals attend each meeting. Each meeting, in effect simply a discussion group, is planned and conducted by the operating and technical divisions. So far the programs have included discussions on the operating standards and manuals; why control points were established, and other data which have resulted in the written work. Motion pictures are frequently scheduled, too, to supplement information of specialists.

During these meetings, operators are encouraged to ask questions. If the answers are unavailable immediately, every effort is made to obtain and supply them while, at the same time, definite attempts are made to present information which can be accepted easily by the persons in attendance, rather than to present highly technical information which is oblique and beyond comprehension.

These meetings provide management with an opportunity also to give the operators a pat on the back for jobs and performances that deserve praise. Similarly, an opportunity is provided the employees for expression of any opinions they might have.

Management at the East St. Louis refinery points to its training program as important to the company and to the employees in a number of respects.

Purely as a matter of economics, it is pointed out that definite savings in money can be accomplished when operators are assisted in doing their jobs to the best of their ability. For instance a difference of a few degrees in operation at a particular point of a unit can cost the company as much as $100 per day unless the employees are impressed with the need of less variation in temperatures. Proper conservation of butane and directing it to its proper uses can save $2 per barrel.

More satisfactory labor relations result when each operator or stillman understands perfectly his part in the refinery's whole production system and the responsibility that is his for doing each of his tasks as well as he knows how. Reliability increases in direct proportion to the confidence a man feels from *knowing* what he is doing.

This training system at East St. Louis proved its value early. In 1946, after establishment of the program, throughput in the crude unit, where the program was first installed, averaged in excess of 22,500 barrels per day, compared with 21,000 barrels in the year preceding—and the latter figure had been considered top operation. By 1948 even higher throughputs were being handled successfully.

The 90-per cent point of the straight-run gasoline controlled by laboratory tests—with operators making adjustments primarily on the basis of their own judgments until tests were obtained—had varied more than 20 degrees Fahrenheit from day to day. Following establishment of standards and proper training of operators, the 90-per cent point of the straight-run gasoline varied less than six degrees Fahrenheit and the control points were the temperature and pressure at the top of the tower rather than the result of laboratory tests. Such results of the training program are still being recorded and, it is expected, will continue to be recorded as the system progresses.

An incidental benefit from this training program is in connection with operating personnel sent from other plants to the East St. Louis refinery for training in catalytic cracking. The data available in manual form have materially decreased the time required to train these guests adequately. In addition, the confidence of the process operators in being able to teach these guests has been increased to the point that a considerable portion of the technical staff's burden for outsiders' training has been reduced.

The East St. Louis refinery realizes that the training program needs expansion to the lower levels of employees to provide fundamental information to employees newly assigned to the Operating Division, as well as training in techniques of firing, housekeeping, safety, and other subjects. Thus persons receiving this training will have a better foundation for advancement and a greater appreciation of their responsibilities as they advance. This is uppermost in management's plans for the future, when completion of the refinery's expansion program permits greater time and effort along these lines.

Between the training programs of the two refineries, though, Socony-Vacuum has an excellent opportunity to study the methods of these two systems and possibly, if it ever becomes necessary, to combine the salient points of each in a standardized system for the future for all of its refineries everywhere. ★ ★ ★

Hydrocarbon absorption and fractionation process design methods

Part 19. Equipment Selection and Arrangement

By WAYNE C. EDMISTER*

THE various individual items of equipment employed in hydrocarbon absorption and fractionation operations are fairly standardized as to mechanical details, which makes the equipment selection rather simple. Bubble plates, reboilers and reflux hookups and many other features are established with few and, in most cases, minor variations in design. Although the selection of individual items of apparatus is simplified by the limited number of types available, the arrangement of this apparatus into integrated plants is complicated by the great number of flow sheet possibilities made necessary by the multicomponent nature of petroleum and the large number of varied quality products.

In this installment the different types of apparatus and equipment arrangements are discussed in preparation for the outlining of overall design procedures in the following and concluding chapter. In the previous chapters the theoretical design methods and the capacity and efficiency of bubble plates were presented. Before these calculations can ever be started it is necessary to have a flow sheet, tentative or final, for the operation. The development of such flow sheets requires know-how acquired from operating experience. Much time can be saved in the design work by having as complete and final a flow sheet as possible at the beginning of the actual calculations.

Apparatus to be covered in the discussion in this installment will include: (a) contacting devices, (b) reflux condenser hookups, (c) reboiler hookups, (d) absorber variations, and (e) split two column fractionator. Equipment arrangement is illustrated by three alternate schemes for separating cat-cracker products and also by an absorption system wherein the lean oil is recycled to the main fractionator in the cracking unit.

At the end of this installment are many references of interest on this subject. The articles on batch distillation, packed columns and perforated plates are included for reference. These subjects are mentioned briefly, but not developed because of space limitations.

OTHER CONTACTING DEVICES

In addition to bubble cap plates for contacting vapors and liquids in absorbers and fractionators, other types of contacting devices are occasionally used in hydrocarbon separation operations.

*Carnegie Institute of Technology, Pittsburgh, Pennsylvania.

Perforated or sieve trays have been used successfully and in increasing number during recent years. Perforated trays, which are installed with weirs and downspouts have been used to replace bubble cap plates in towers where additional capacity above that obtainable with the bubble cap plates is desired. Perforated trays are good high capacity contact devices, but they do not have much capacity flexibility and cannot be operated satisfactorily at a greatly reduced throughput, as can bubble cap plates.

The holes in perforated plates must be of such a size and number that the liquid will not weep through them during operation with gas flowing up the tower and with an adequate depth of liquid on the tray to obtain good vapor-liquid contact. It is necessary to make the holes small and take some gas pressure drop in order to get efficient operation. Gunness & Baker[14] reported performance data on a perforated plate beer still. They reported lower efficiencies than for bubble cap plates in similar service, but this is probably due to the fact that the holes were relatively large, which was said to be necessary to avoid plugging and cleaning difficulties. Kirschbaum, [16, 17, 18] has obtained data on perforated plates and developed methods of calculating the hole sizes.

Perforated plates have been used to a limited extent in the petroleum industry, but very little has been published on their performance. In several instances perforated plates have been installed in existing columns as replacements for bubble cap columns where increased capacity is required. Such replacements have been successful after the proper number and size of holes has been found. Trial and error in operation was sometimes necessary. Calculations alone have not always been sufficient. More exact methods of designing perforated plates would be worthwhile, particularly for dirty stocks because of the ease with which perforated plates can be cleaned.

Packed columns have many applications in hydrocarbon processing industries, but mostly in small scale units, such as laboratory columns for analytical and pilot plant work. Practically all of the commercial scale absorbers and fractionators used in the petroleum industry are bubble plate columns. For this reason calculation methods for packed towers have not been given any space in this series. A complete treatise of absorption and distillation should include packed columns, however.

In the early days of the petroleum industry packed columns were used almost exclusively. Usually, the packing materials were crude: ceramic, stones, brick segments, etc., or metallic pipe nipples, collars, etc., shapes dumped into a tower in a haphazard manner. In addition little attention was given to vapor and liquid distribution. While the petroleum industry was operating equipment of this kind the alcohol industry was using more efficient bubble plate units. Gradually the petroleum industry adopted the bubble plates and went ahead to develop the science and art of distillation to a higher degree of perfection. With the use of perforated plates the petroleum industry is borrowing another page from the alcohol industry's book.

Recent developments in hydrocarbon processing, such as: the isolation of pure compounds by precise fractionation and synthesis of chemicals from hydrocarbon raw materials, have created attractive applications for packed columns. One of the foremost packing materials is the Stedman triangular pyramid type of packing, which has been described in the literature by the inventor[23] and by Bragg et al.[5, 6] This packing, which is made from stainless steel cloth by stamping and welding layers together, possesses a large amount of contacting area per unit of length.

Most of the Stedman units have been small diameter columns for pilot plants, fractional analysis units and for reference fuel preparation. Recently one large unit was built for fractionating naphtha to make aviation base stock. This unit, which is described by Bragg & Morton[6] is 11 ft in diam and 15 ft high and is operated as a batch distillation unit. In a tower of this kind equal distribution of liquid flow through the packing is a particularly difficult problem. In addition to a positive foolproof reflux distributor at the top, it is necessary to have redistribution zones and devices at frequent levels in the column.

Large diameter packed columns of this kind might be attractive for special separation jobs. In general, the consideration that recommends a packed unit is small size rather than large size, however. This is due to the fact that bubble plates cannot be installed in small diameter towers so packing must be used for low capacity operation. The minimum diameter for bubble plates is fixed by the

EXCLUSIVE

space in which a man can work to install the plates and caps. This diameter is between 30 in. and 36 in. For smaller diameters, packing is frequently used. A relatively higher proportion of the separation operations in the chemical industries are below this minimum size than in the petroleum industry. The packed column is more widely used in gas absorption than in rectification.

Many other packing materials have been used, namely: Berl Saddles, Raschig rings, carbon rings, wire helices, etc. These packing materials vary in efficiency and in capacity, efficiency being measured in H.E.T.P. (height equivalent to theoretical plate) and H.T.U. (height of a transfer unit), while capacity is indicated by the flooding velocity. Both liquid and vapor quantities affect the efficiency and capacity as do the properties of the fluids. Packed column capacity has been investigated by theoretical and experimental studies of which the articles of Bertetti[2] and Lobo et al[19] are representative. The latter articles include empirical correlations for predicting the limiting capacity of dumped tower packings. Special packing, like Stedman, that is precisely assembled rather than dumped, was not included in general correlations. Capacity factors are usually developed by the manufacture for these special packings.

Absorption and distillation in a packed column differs from the same operations in a bubble plate column in a fundamental respect, namely: packed column operations are continuous differential processes while bubble plate operations are discontinuous stage processes. In a packed column the vapor and liquid flow countercurrent to each other. In a bubble plate column the flow is countercurrent between stages, but approaches cross flow in each stage. Thus, it can be seen that the interphase material transfer in these two cases has different driving force conditions. In the multistage bubble plate operation the concentration differences vary as equilibrium is approached. In the packed column there are no stage approaches to equilibrium.

Packed column design calculations may be made in two ways: (a) theoretical or equilibrium plate computations combined with H.E.T.P. values for the particular packing and fluids involved, or (b) solution of differential material transfer equation with the appropriate mass transfer coefficients combined with H.T.U. values for the particular packing material being used. The later procedure is the theoretically correct method. H.T.U. is fundamental while H.E.T.P. is only empirical. The H.T.U. values enter the calculations directly, while the H.E.T.P. values are applied as an overall equilibrium efficiency. In these respects H.T.U. and H.E.T.P. are analogous to the Murphree and the overall plate efficiencies, respectively.

Packed column calculation equations and methods are developed, discussed and illustrated in the technical literature, many references from which are given at the end of this installment (1, 4, 7, 8, 13, 22). These references are recommended for those interested in packed column calculations. The most recent of these worthy contributions to the technical literature, namely the article by Bowman and Briant[4], develops the theory of batch and continuous rectification in packed columns. The mathematics of the differential solution to packed column distillation is more complex than the simple algebra of the theoretical plate solution for multistage distillation.

As stated above the theoretical plate method can be applied to packed columns with success provided H.E.T.P. factors are available. Unfortunately, these data are not available in sufficient abundance to justify using this design method in preference to the more rigorous differential method with H.T.U. factors.

BATCH DISTILLATION

Practically all fractionation operations in the petroleum industry are continuous rather than batch. For this reason the theory and calculation methods of batch distillation are not included in this series. For those interested, several references on this subject are given (2. 9, 10, 11).

Batch distillation is an unsteady state operation, wherein column holdup is an important consideration. With liquid of varying composition distributed in the column from reboiler to condenser and with liquid reflux running down the column the rising vapors from the reboiler will push the more volatile components up the column while the reflux will pull down the less volatile components. In this way the components of a mixture are sorted out so that they go over in order of increasing boiling points.

Because of this unsteady state operation, different calculating methods are required for batch distillation. For batch, as for continuous distillation, either packed or bubble plate columns may be used and calculation methods will differ accordingly.

It might appear that batch distillation could be considered a series of infinitely small continuous distillation operations with changing feed and product compositions. Such a picture would have to be qualified by the following facts: (a) there is no removal of bottom product, and (b) there is no distinction between enriching and stripping sections as the enriching and stripping take place simultaneously on the same plates in batch distillation. In batch distillation the system is gradually being depleted of the more volatile components while the heavier ones remain in the still until the end.

The analytical solution of batch distillation has not been completely developed to the writer's knowledge.

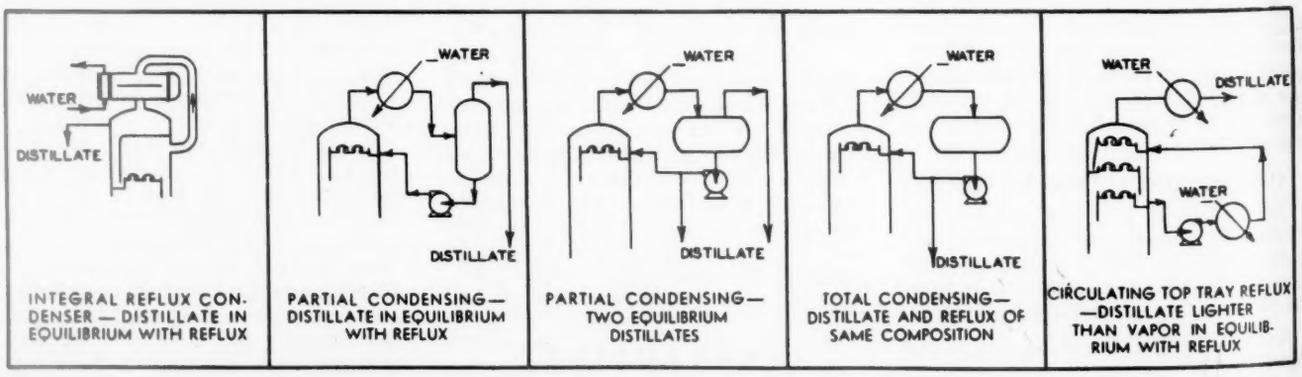
REFLUXING HOOKUPS

Fig. 81 shows five alternate hookups for condensing and returning reflux to fractionators. These are schematic and not intended to indicate the proper elevations of condensers, pumps or drums. There may be other arrangements, but these are believed to be representative.

The integral reflux condenser is not used very much in the petroleum industry because of the inaccessibility of the condenser and the additional structural steel required to support and service the condenser. This is the only alternate where the location of the auxiliaries is not flexible. For the other four, the condenser may be located at some intermediate level between the ground and the top of the tower.

The second, third and fourth arrangements are the most common. These three differ only in the completeness of condensation. In the second only the reflux is condensed, whereas part or all of the product is condensed as well in the other two. A partial reflux condenser

FIG. 81. Five alternate refluxing arrangements for fractionators.



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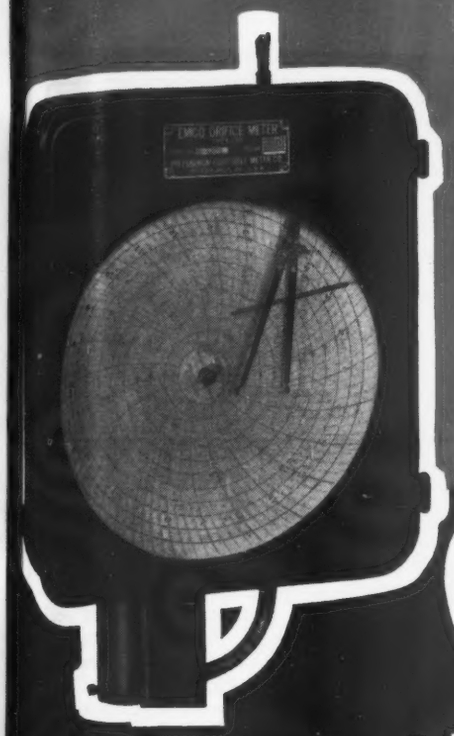

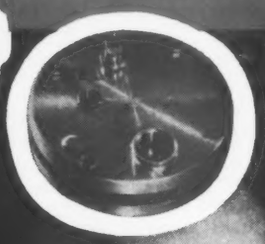

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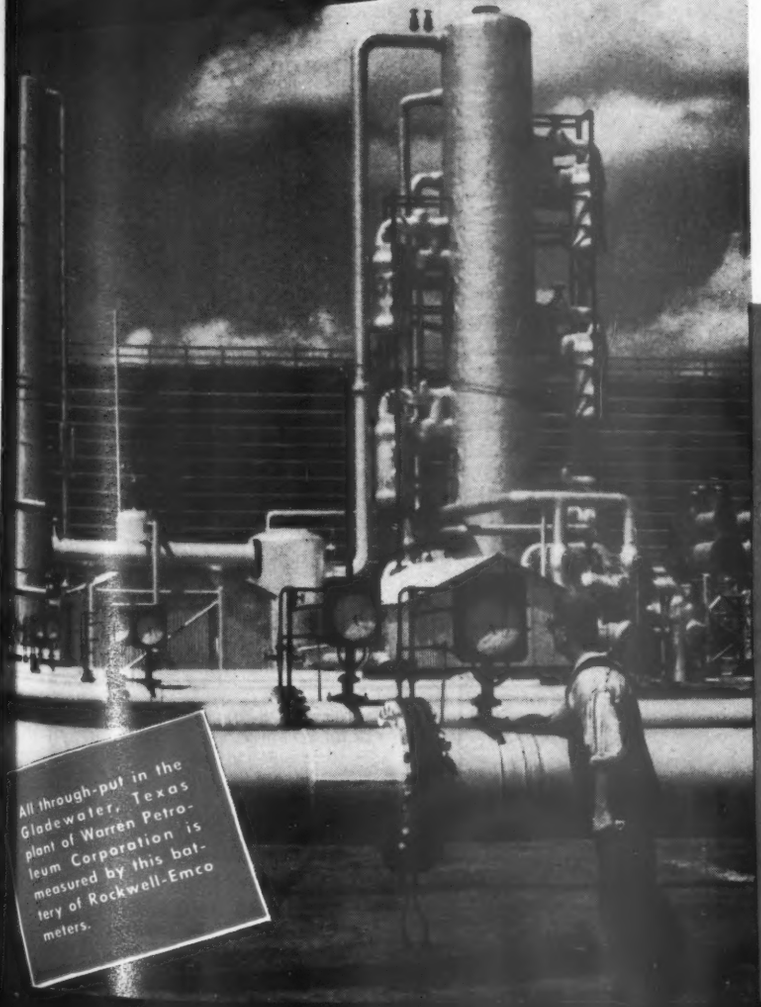

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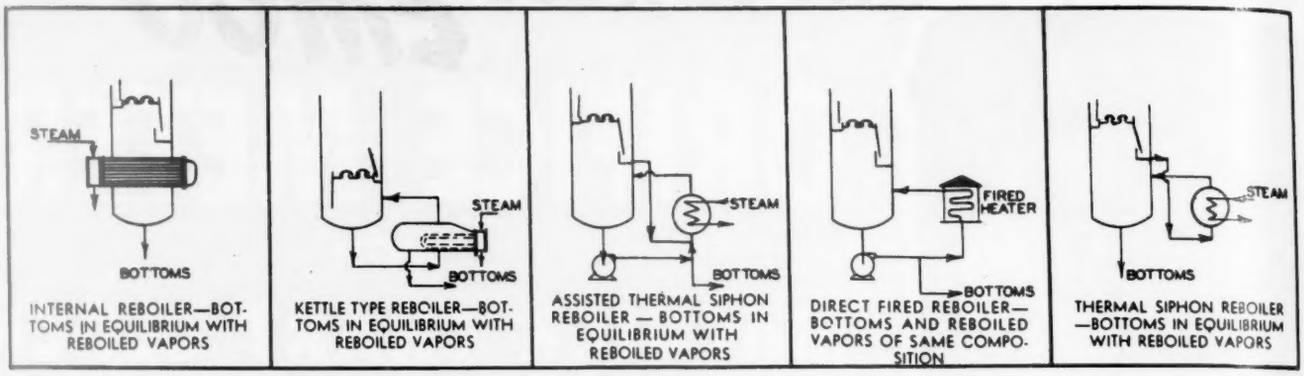

FIG. 82. Five alternate reboiling arrangements for fractionators.

is another plate, but of a different efficiency than the plates in the column.

If the distillate product is to be condensed it could be done in a separate condenser by adding another condenser to the second arrangement. This would have the advantage of doing most of the condensing with a higher temperature cooling water and keeping the low temperature condensing load at a minimum. Partial condensers are usually easier to control so it is preferable to avoid total condensation where possible.

The fifth refluxing arrangement is the circulating top tray reflux system. This scheme is frequently used on cracking unit fractionators cutting the gasoline end-point; in other words, for columns where the overhead distillate is gas and gasoline. In such operations, precise separations are not necessary because the next cut (naphtha or kerosine) may have a low enough initial to allow for some overlapping of the distillation curves.

The advantage of the circulating top tray reflux is that heat is taken out at such a level that heat exchange with incoming crude or gas oil feed may be used to preheat the change to the unit and at the same time remove heat from the tower. The disadvantage is that about three plates extra must be included as heat exchange plates. Another disadvantage is that a large amount of liquid must be recirculated to remove the heat because sensible heat only is picked up by the circulating oil.

REBOILING HOOKUPS

Fig. 82 shows five alternate hookups for reboiling fractionators. These diagrams are also schematic and not intended to show the correct relative locations of the tower and auxiliaries.

The internal reboiler is hardly ever used in the petroleum industry. An internal reboiler is difficult to clean and to do so requires shutting down the tower. With an external reboiler, such as those shown in the other four sketches, it is possible to have duplicate reboilers thus making it possible to run on the spare when the reboiler fouls up.

The kettle type reboiler is widely used in the petroleum industry because of the flexibility and ease of control made possible by the large liquid hold-up in the bottom of the tower and in the kettle. In this installation the reboiler is also another plate with the liquid to the reboiler being split into bottoms product and vapor that returned to the column. These reboiler effluent streams closely approach equilibrium with each other because of the long time of contact furnished by this type of reboiler. The downspout from the last tray seals in a pool of liquid in the bottom of the tower. It will be noted that in the other four reboiler hookups the liquid seals are in segmental pans or boots that either overflow or supply the reboiler through a withdrawal line.

The third reboiler arrangement is an assisted thermal siphon where the liquid to the reboiler is liquid from the bottom tray plus some of the bottoms products.

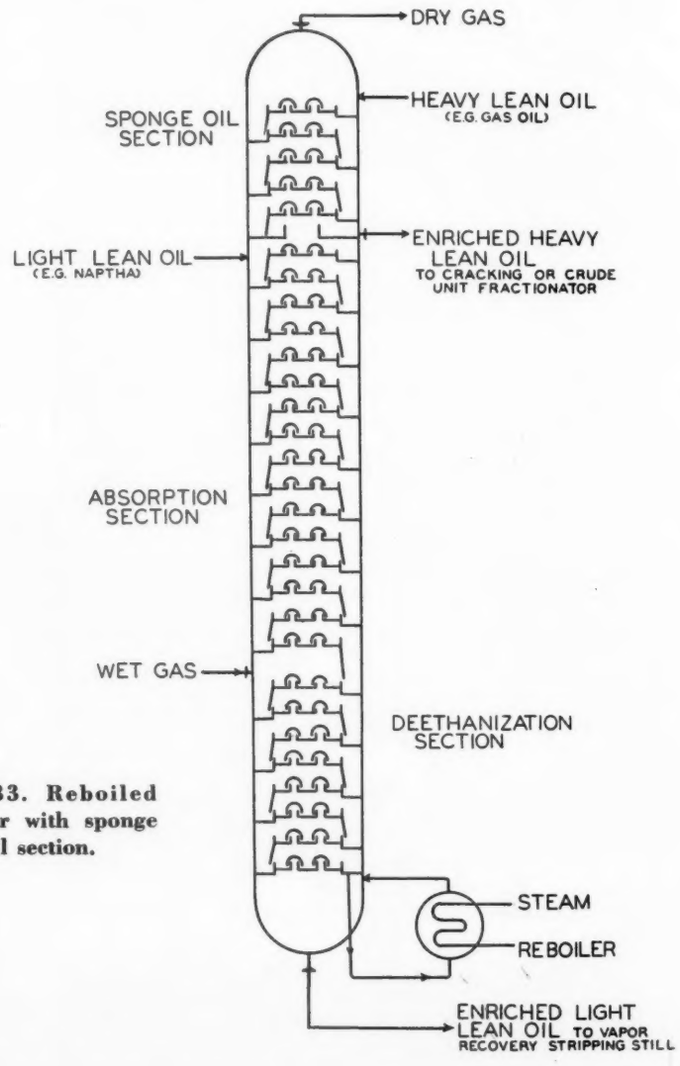

FIG. 83. Reboiled absorber with sponge oil section.

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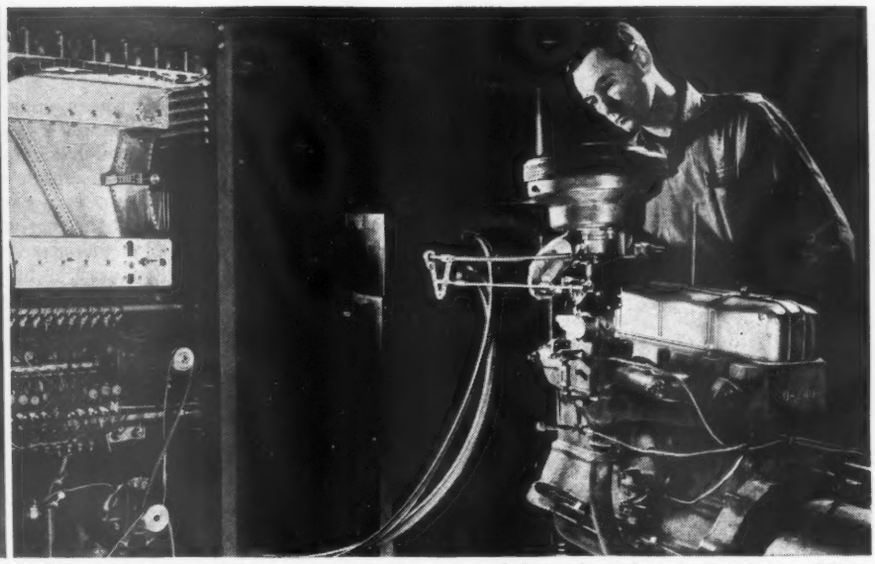

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In this case, as for the kettle reboiler and the 100 per cent thermal siphon reboiler, the reboiled vapors are in equilibrium with the bottom products. The analogy between the third reboiler and the third reflux arrangement are noteworthy.

In some cases direct fired reboiling is necessary because the high temperatures required are above that obtainable by steam. For safety reasons the fired heater is located a distance from the tower and part of the tower bottoms pumped through, as shown in the fourth sketch. In this operation the reboiler is not another contact stage. An advantage of a direct fired reboiler is that the heat is obtained from the fuel directly without employing an intermediate heat carrying fluid, like steam, which requires steam boiler surface in addition to reboiler surface.

In many refineries there is hot gas oil or tar that can be used as a source of reboiling heat. Such heat carrying fluids cause fouling troubles, however, so it is customary to have two reboilers and/or spare tube bundles when hot oil streams are used for reboiling. In addition the tube bundles are made on square pitch to facilitate cleaning.

The fifth installation shown in Fig. 82 is a straight thermal siphon unit where the entire trapout quantity goes through the reboiler, where it is partially vaporized and returned to the bottom of the column. Difference in static heads of the liquid trapout and the mixed vapor and liquid in the reboiler leg of the manometer cause the flow. This type of reboiler also serves as an additional equilibrium contact.

Of the five reboiler installations shown, the thermal siphon one is probably the most difficult to design because of the thermal siphon effect with mixed phase flow in the reboiler. Practical experience is more important in sizing the lines and exchanger for this installation than for the other schemes.

ABSORBER VARIATIONS

Fig. 83 shows an absorber with a de-ethanization section and a sponge oil section. Absorber reboiling is practiced to remove the ethane from the rich oil. By eliminating the ethane at the absorber, along with the methane, the stabilizer can be operated at a lower pressure with the same cooling water. The presence of ethane makes higher pressures or low temperatures necessary. Both of these are costly so ethane should be rejected if possible.

The sponge oil section is shown at the top of the absorber to illustrate one of the most effective means of keeping lean oil losses down. A sponge oil section is not a necessary feature of a reboiled absorber. A sponge oil section may be used on any absorber to reduce the lean oil loss.

Both de-ethanization and sponge oil sections may be in separate vessels or they may be integral parts of the absorber as shown in Fig. 83. The latter may be excessively high in some cases and make it essential to divide the unit for physical reasons.

Whistler[25] describes some commercial applications of fat-oil de-ethanization, presenting some operating data. In the system described, the reboiling of the fat oil is done in a separate tower, consisting of a reboiling section below a small absorption section, over which some of the same lean oil used in the main absorber is used to retain the propane and propylene while boiling out the methane and ethane. This unit is essentially a fat-oil fractionation column refluxed with lean oil. With a separate fat-oil fractionator, such as the system described by Whistler[25], the main absorber is of conventional design and not complex like the one shown in Fig. 83.

With the reboiled de-ethanization section below the main absorber, as shown in Fig. 83, the component distribution-theoretical plate calculations are very complex. On the other hand the two-stage system described by Whistler[25] is susceptible to straight forward calculations, because the two absorption operations are carried out in separate absorbers, rather than in one.

The fat oil reboiling could be done to remove methane with ethane retention as well as to remove both methane and ethane with propylene retention, depending upon the desired products.

A light low molecular weight lean oil is a more effective solvent than a heavy lean oil for hydrocarbon absorption. The draw back to a light lean oil is the loss from the top plate into the off gas. This lean oil loss can be calculated by the methods outlined in Part 9 (*The Petroleum Engineer*, January, 1948). In some installations the lean oil loss is appreciable and cannot be tolerated. This lean oil can be recovered from the off gas by sending it through a second absorber, called sponge oil section, using a heavy oil and designed to recover the lean oil components only.

High pressure absorbers are now used extensively in many plants. Twenty-five years ago most all of the absorbers in the natural gasoline industry operated at pressures below 50 psig and the refineries were no higher, if as high. In those days the marginal hydrocarbon product was butane. Now propane is in great demand and many plants go after ethane. This increased demand for the lighter hydrocarbons plus the development of the recycle plants for condensate production and reinjection of the stripped gas for pressure maintenance have raised absorption operating pressures.

Absorber pressures as high as 2000 psig are being used in the recycle plants. In one such plant described by Wade[24] there were four absorbers (operating at 1800, 600, 200 and 40 psig) and rejecting four separate dry gases. Each absorber was supplied with a different lean oil. The gas feed to the lower pressure absorbers come from flashing the fat oil from the absorber of next highest pressure.

Kirkbride and Bertetti[15] have experimentally determined the vapor liquid equilibrium constants for methane, ethane, propane, butane and pentane in paraffinic, naphthenic and aromatic lean oils for pressures up to 3000 psia. At these pressures the systems are non-ideal so the customary theoretical K-values that are independent of composition, etc. cannot be used.

Another example of special absorption is the hydrogen enriching operation in the hydroforming units, where the product gases are put through two absorbers, one to collect the C_3 and C_4 hydrocarbons and the other to remove methane and heavier from the gas mixture to leave a gas consisting of about 80 per cent hydrogen. The latter required the use of a large absorber and tremendous quantities of lean oil.

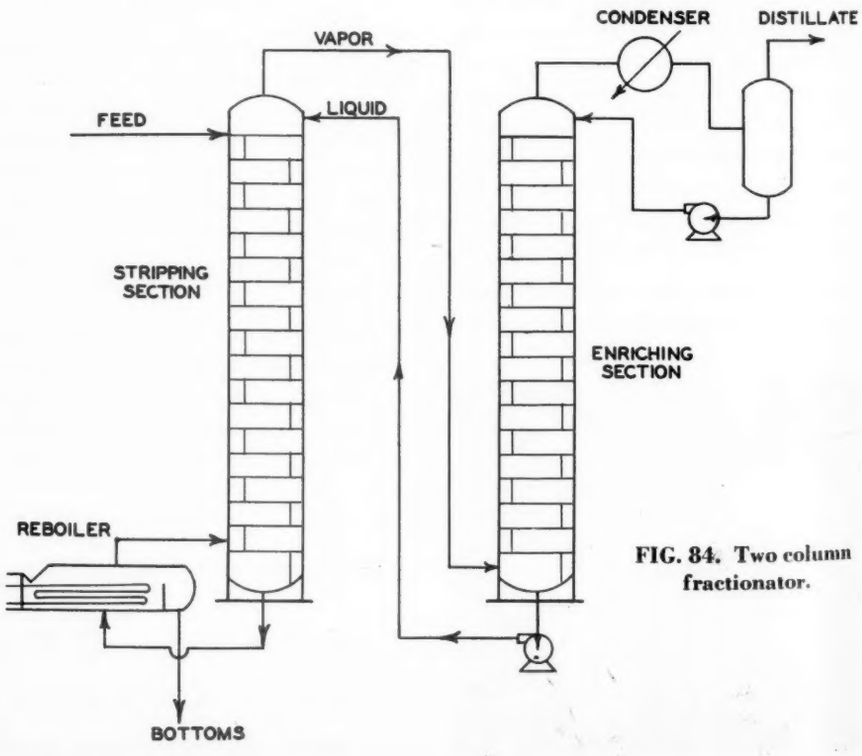


FIG. 84. Two column fractionator.

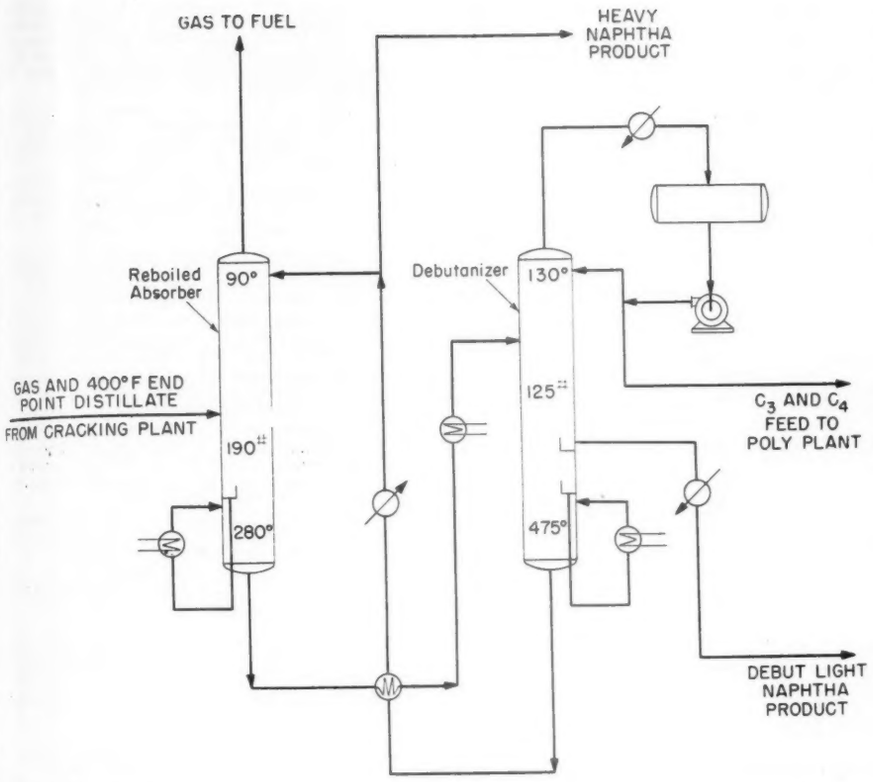


FIG. 85. Hydrocarbon vapor recovery and fractionation plant—two tower system.

SPLIT FRACTIONATOR

Fig. 84 illustrates a split fractionator, with the enriching section in one column and the stripping section in another column. Fabrication in two parts this way is practical when the height of one single tower would be too great for shipping and erection.

The fractionator shown in Fig. 84 is split at the feed point, but it needn't be divided at this point. It could be divided at any other point. Also the feed is shown being introduced into the top of the stripping section. If the feed is a vapor it could be introduced at the bottom of the enriching section.

MULTICOLUMN VAPOR RECOVERY PLANTS

The separation of hydrocarbon mixtures into desired products involving the use of several columns for absorption, stripping, depropanization, debutanization, etc. There are many arrangements of equipment possible, depending upon the separation job to be done. There are usually alternate schemes for the same separation. Two articles on multicolumn fractionation, one by Lockhart[20] and one by Parker[21], discuss this subject and present some operating data.

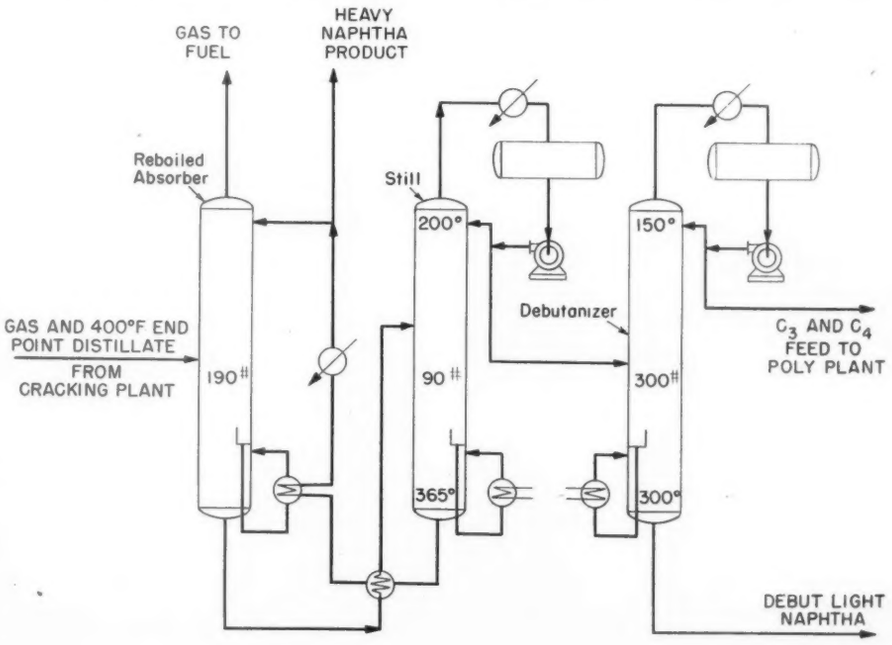
As examples of the type of hydrocarbon separation processes in commercial use, flow diagrams of three schemes to carry out the same job are presented as Fig. 85, 86 and 87 which are two, three and four tower vapor recovery and stabilization units for handling the gas and gasoline products from a catalytic cracking unit. The charge stock to each scheme is the same and the products are essentially the same, the differences being in light hydrocarbon losses and sharpness of separation. The products are: (a) fuel gas, (b) C_3-C_4 poly plant feed, (c) debutanized light naphtha and (d) heavy naphtha. In all cases the lean oil is a recirculated portion of the charge. The advantages and disadvantages of each scheme should be apparent from the flow diagrams. In general, it can be stated that more towers increases the cost of the equipment and also efficiencies of recovery and separation and of energy utilization. These three flow sheets were discussed briefly recently[12]. In the two tower system, shown in Fig. 85, the fat-oil is reboiled to remove C_1 and C_2 and the heavy naphtha lean oil is made in the lower part of the debutanizer. With a still added the debutanizer becomes a normal tower and the flows shown in Fig. 86 result. With two stills, one high and one low in pressure, and gas recycle the four tower system shown in Fig. 87 is developed. Absorber reboiling could be used instead of gas recycling in the four tower system if desired. The operations of the two stills in Fig. 87 are very complex to compute because of the half series and half parallel hookup. Recycling the gas also makes the calculations complex.

The two tower system, shown in Fig. 85, is the simplest, but it requires a high level heat to reboil the debutanizer and the absorber operates at a high pressure with a higher lean oil loss in the fuel gas, i.e. higher than in a system employing a separate stripping still.

Adding a still to give the three tower system, shown on Fig. 86, gets around two of the disadvantages of the two tower system; namely, the temperature in the debutanizer is not as high and the lean oil is better stripped. However, the absorber pressure is high, thus requiring relatively high gas compression power. Adding a second still to make four tower system as shown in Fig. 87, permits lowering the absorber pressure. Advantages of the four tower system are: (a) lower absorber pressure, (b) more thoroughly denuded lean oil and less lean oil and condensable losses, (c) lower temperatures and lower grade heat for reboiling.

The type of process determines the level and the source of reboiling heat,

FIG. 86. Hydrocarbon vapor recovery and fractionation plant—three tower system.



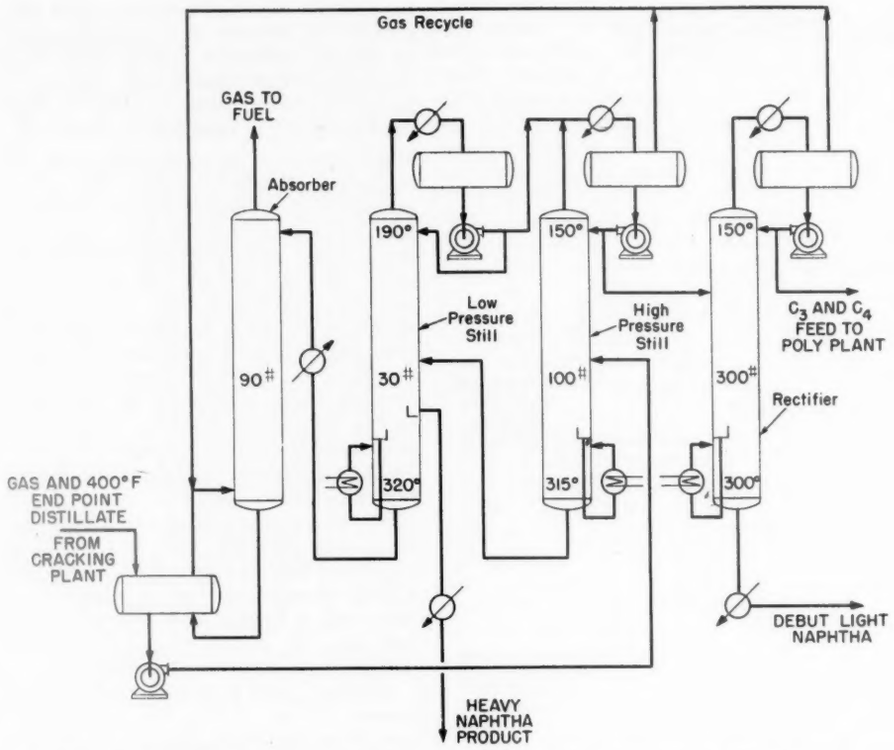


FIG. 87. Hydrocarbon vapor recovery and fractionation plant—four tower system.

which influences the design of the reboiler. Steam, hot oil or direct fire heat reboilers are used.

Another vapor recovery scheme is shown in Fig. 88, which is a frequently used system for small cracking units. The lean oil for the absorber in this system is taken from the main fractionator and the rich oil is returned to the same tower for stripping. Thus, the main fractionator serves as a still. There are two recycle streams in this flow sheet, one from the debutanizer reflux drum back to the absorber and the other via the rich oil through the fractionator and back to the debutanizer feed accumulator where only mols that remain liquid have a chance to be recovered without further recycling.

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The concluding article of this series will be published in an early issue.

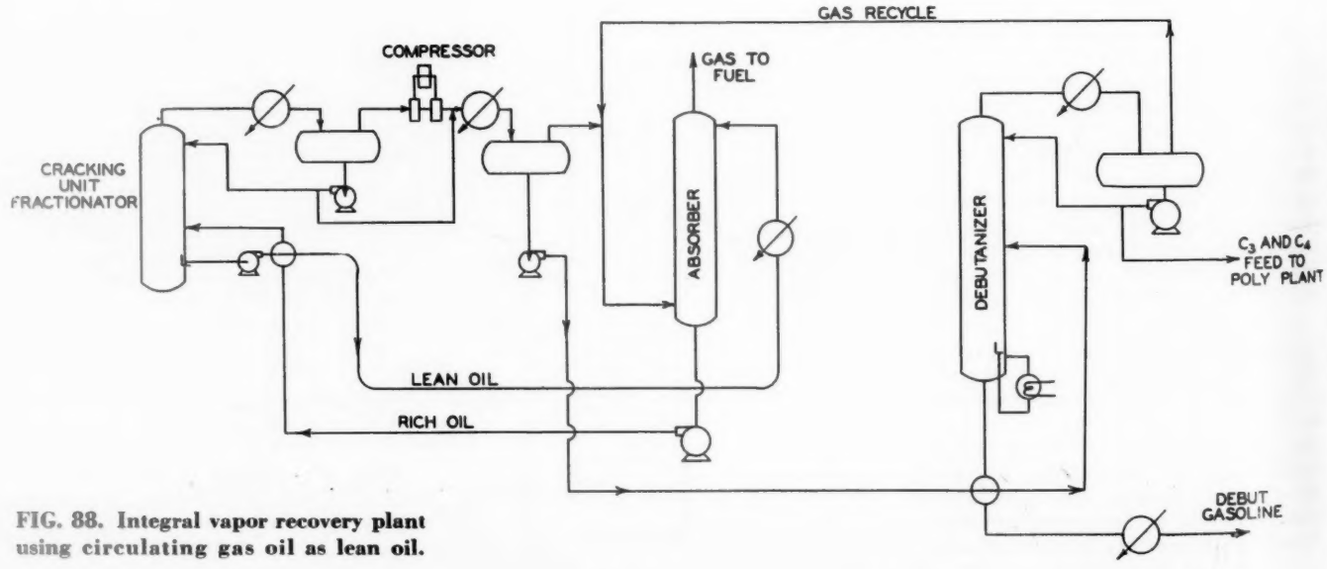


FIG. 88. Integral vapor recovery plant using circulating gas oil as lean oil.

P 260.
P 765.

Four-Bearing Lubrication Testing Machine

IN the investigation of several factors affecting lubrication of journal bearings the National Bureau of Standards has developed a method for testing the effect of different variables on lubrication and bearing performance by measuring the combined frictional and thermal behavior in journal-bearing lubrication.

The four-bearing friction machine, developed and used in former investigations at the National Bureau of Standards, consists essentially of four test bearings on a common shaft. The bearings are mounted in self-aligning ball-bearing swivels which are prevented from rotating by flat springs. The two outer bearings are fastened to the housing whereas the two inner ones are located in plates that slide in guides (Fig. 2). The complete housing floats on the horizontal shaft and acts as a cradle dynamometer. Load is applied by hydraulic jacks under the two inner bearings.

Oil is fed to the bearings through the drilled shaft, which has two oil holes at the longitudinal center of each bearing. A motor-driven pump and a relief valve maintain the oil-feed pressure. Bearing temperatures are measured by thermocouples imbedded in the metal at the loaded sides of the bearings.

A study of the frictional-torque data for operation under load indicates that when a bearing is operating at a constant speed, using a given oil at constant oil-inlet temperature and oil-feed pressure, an increase in load produces an approximately proportional increase in frictional-torque. The increase in torque with unit increase in load is influenced chiefly by the viscosity of the oil, the oil-inlet temperature, the oil-feed pressure, the clearance-diameter ratio, and the length-diameter ratio.

The results also indicate that, under these operating conditions, an increase in load causes a proportional increase in the fluidity of the oil in the bearing. For a given oil, oil-inlet temperature, and oil-feed pressure, this increase in fluidity (reciprocal of viscosity) is a function of the speed of the journal, the diameter of the journal, the length-diameter ratio, and the clearance-diameter ratio. Empirical equations have been developed to define this relationship.

Further details of this work may be obtained by ordering Technical Paper Report No. 1275 from the National Bureau of Standards, Washington 25, D. C. The information is contained also in the paper "Measurements of Combined Frictional and Thermal Behavior in Journal-Bearing Lubrication," by S. A. McKee, H. S. White and J. F. Swindells, ASME 70, 409 (1948).

* * *

FIG. 1. Four-bearing testing machine.

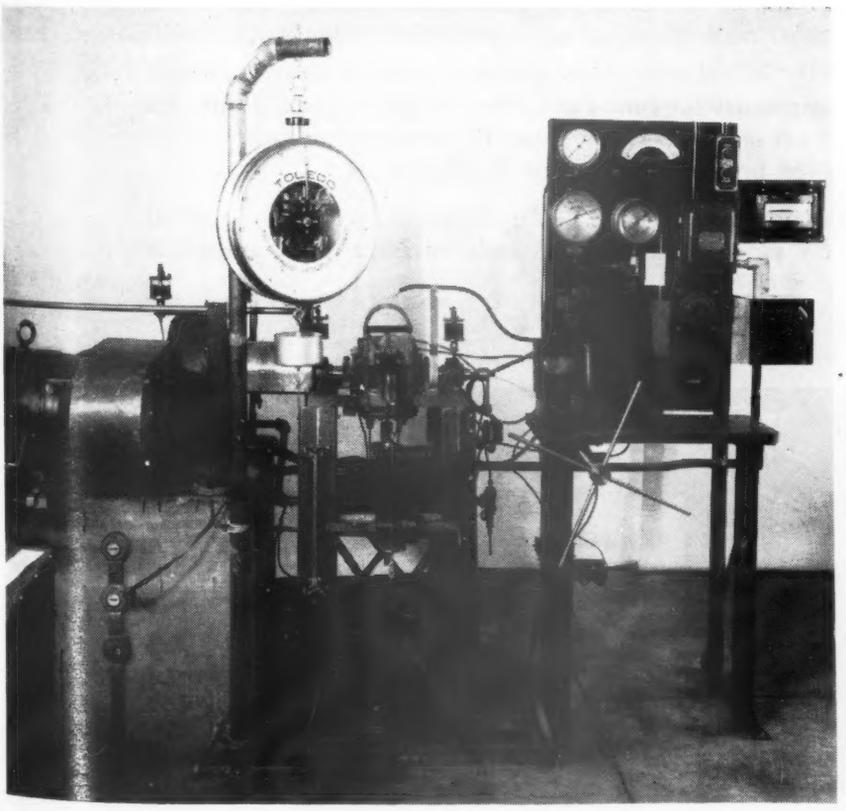
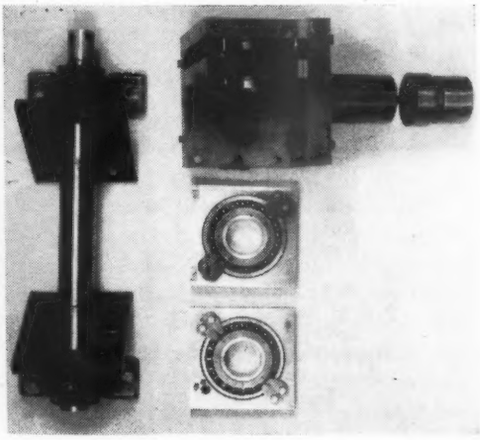
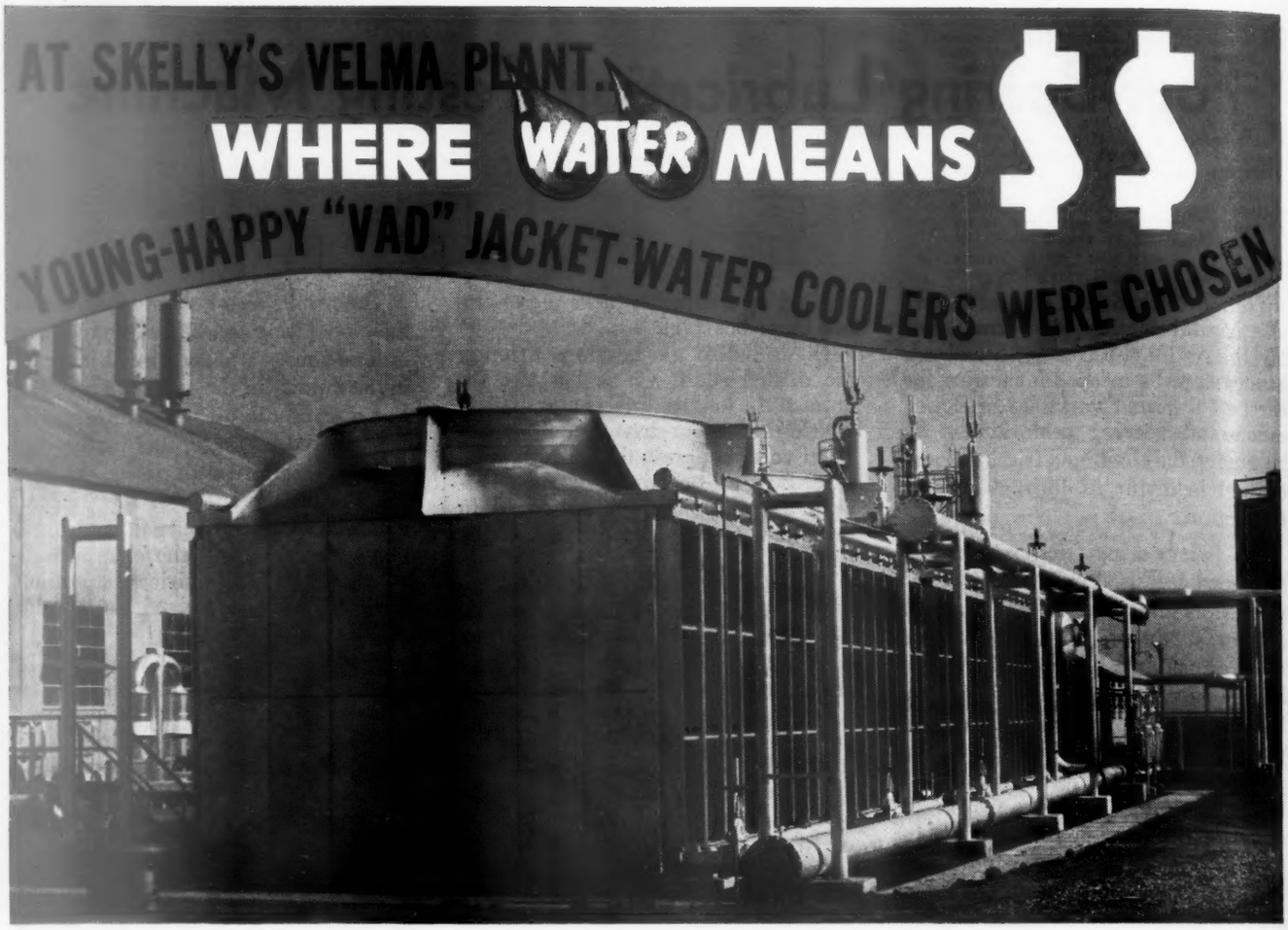


FIG. 2. Bearings in four-bearing testing machine.





Problem: To cool compressor engines rated *7200 HP* total and generator engines rated *1480 HP* total.

Required: Minimum water "make-up"—Low operating cost.

Solution: FOUR Young-Happy VAD-16 units for "air" cooling the jacket water, each with a 16 ft. dia. adjustable pitch fan driven by a 25 HP two-speed motor.

With two-speed motors on four fans, *nine* different speed points are provided to give *low* "year-'round" fan horsepower.
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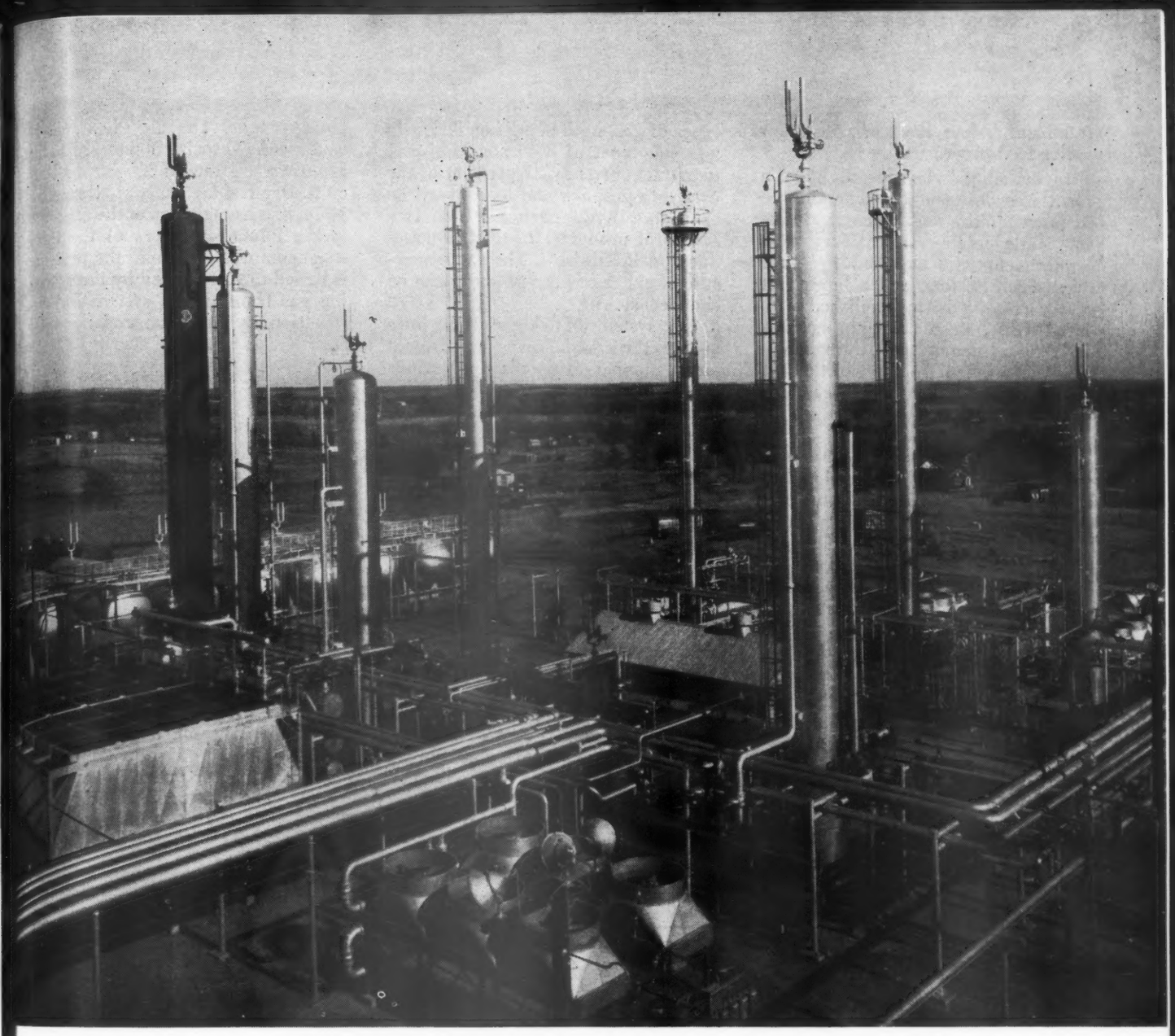


FIG. 1. Hawk's-eye view of the most recent gasoline plant in Oklahoma, Skelly Oil Company's Velma plant.

New Gasoline Plant Uses Direct Heaters

J. C. ALBRIGHT

Two streams of gas, one sour, one sweet are processed in the new Velma, Oklahoma, plant built by Skelly Oil Company; 30,000,000 ft of gas is stripped of natural gasoline and LPG, fractionated in one set of towers. Sour gas is purified by diethanolamine absorption, which removes hydrogen sulphide practically quantitatively before this stream is combined with the sweet gas. Two direct-fired heaters avoid necessity for use of steam boilers in the plant. Aerial coolers make the use of great quantities of cooling water unnecessary, reducing costs and simplifying operation of the plant.

EXCLUSIVE

A VERY modern natural gasoline plant has been built for Skelly Oil Company in one of the most active deep fields, at Velma, Oklahoma, an old producing area in Southern Oklahoma. A very difficult problem was presented by this plant, in that the water supply at Velma is very limited; further, the water that is available has to be subjected to very thorough

treatment before it can be used for boiler feed or processing water.

In the solution of this problem, a plant was designed that contains no steam-generating equipment and uses very little cooling water. Total heat requirements are supplied by three direct-fired heaters, and a large part of the cooling is accomplished with aerial type coolers. This approach has not only overcome the original difficulty occasioned by the shortage of water but it has also had a salutary effect on the three main elements of operating cost.

Since the use of steam has been eliminated, the whole operation has been greatly simplified as compared to conventional gasoline plants and it has been found possible to take care of operating requirements with only four men on each shift. Direct-fired heaters have increased greatly the overall thermal efficiency as compared with plants in which steam stripping is used, with the result that fuel requirements have been reduced to a minimum. Finally, the elimination of a complex distribution system for steam will reduce maintenance cost importantly.

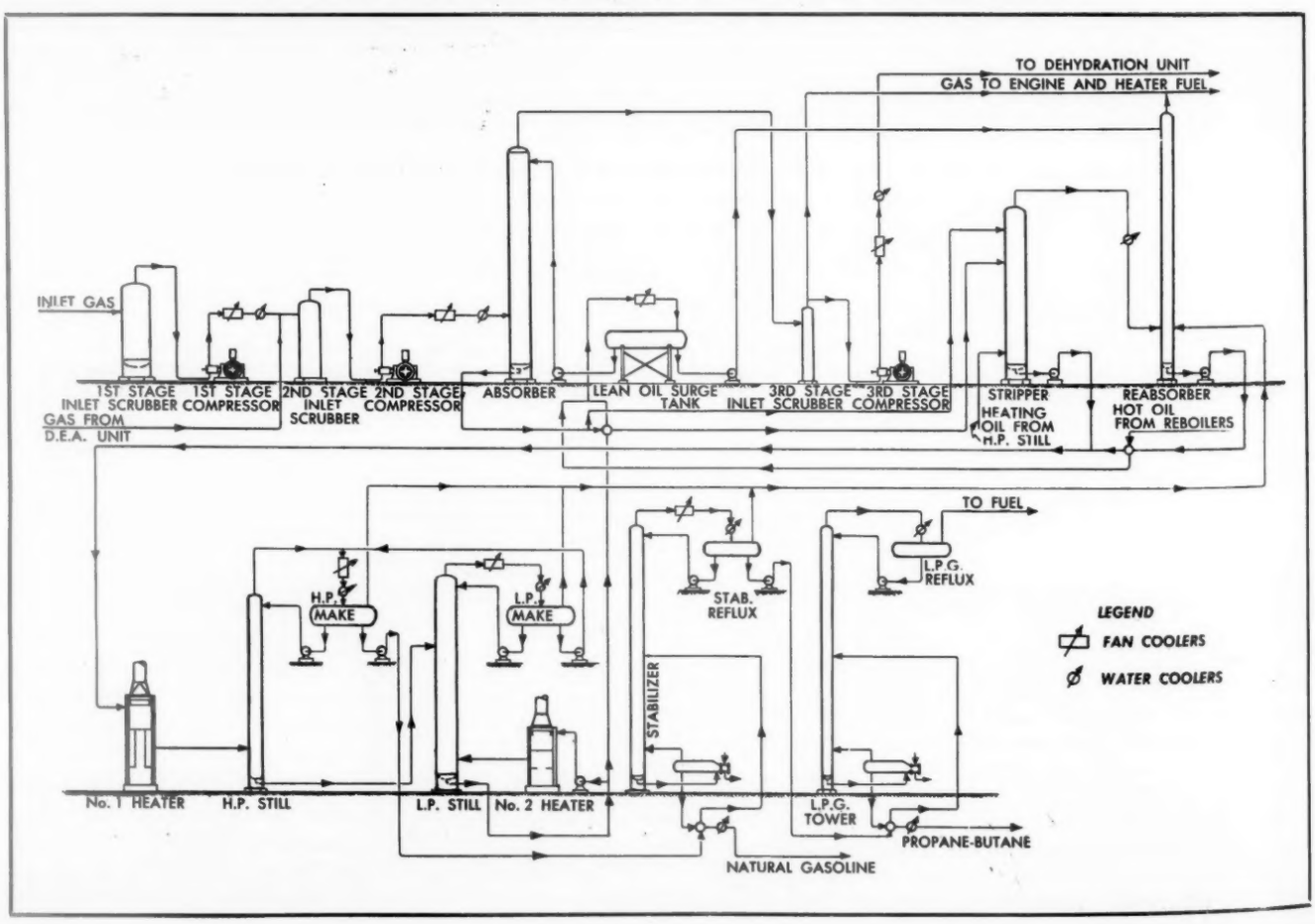
Begun in September, 1948, the Velma plant processes two separate types of gas, both being handled with a common set of absorbers designed to extract currently 57 per cent of the available propane and to convert the extracted hydrocarbons into two grades of products: 12-lb RVP gasoline and 125-lb LPG. The vapor pressure of either or both products can be changed at will.

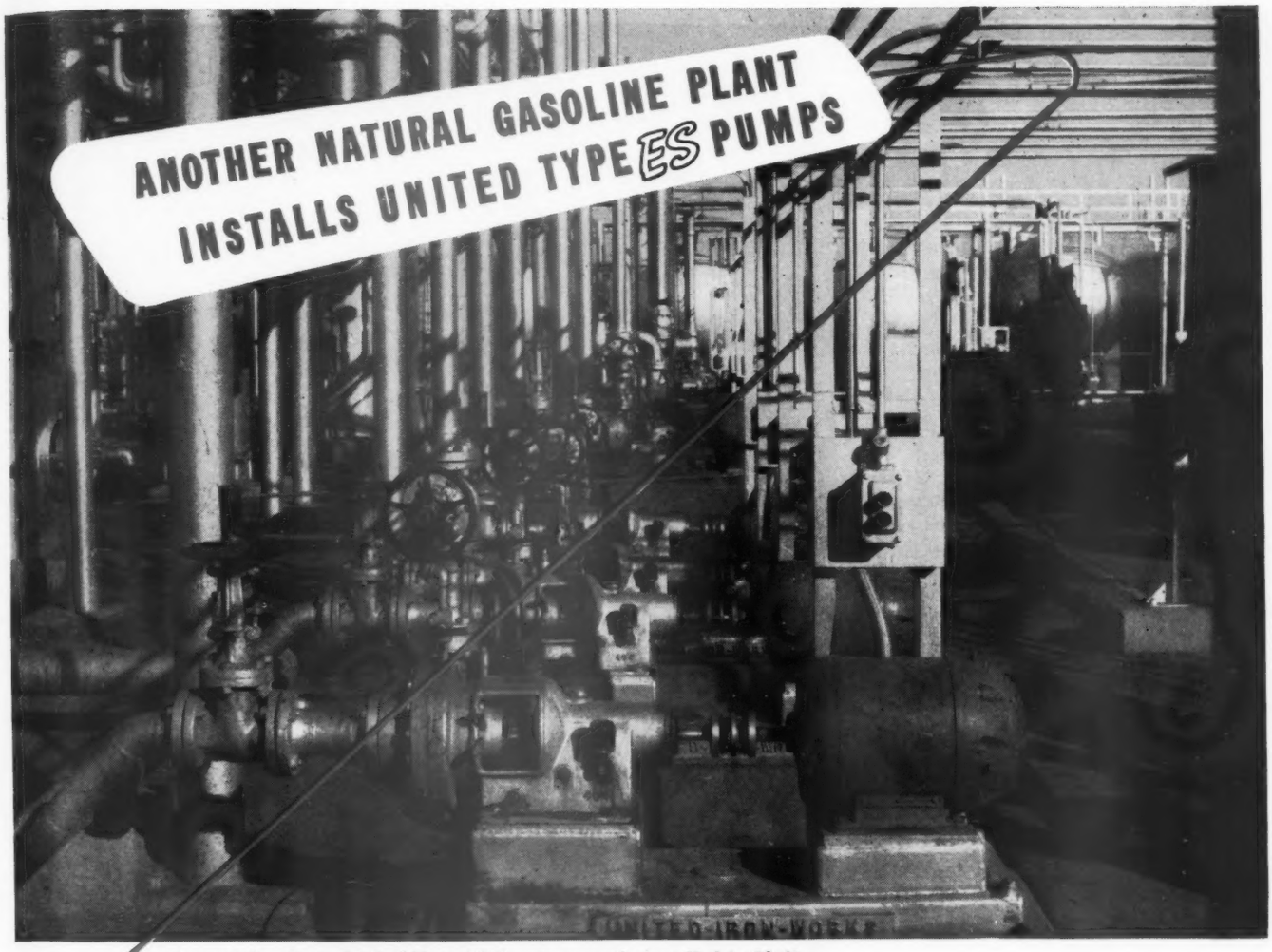
Two systems of field gathering lines pick up the gas and bring it in from a large number of wells of various depths in three separate pools to the inlet scrubbers at the plant. One system handles sour gas, containing hydrogen suphide and mercaptans, that comes into the plant at field separator pressure. The other system supplies gas to the suction of 24 cylinders of the 12 Clark 600-hp gas engines at zero psig. After H_2S extraction, the sour gas mixes with the naturally sweet gas in the inlet scrubbers of the second compression stage, which is obtained with 12 cylinders operating with an intake pressure 40 psig and boosts the combined volume of 30,000,000 cu ft to 195 psig, which is the pressure at which the absorber operates. The blended gas stream is processed in a 7-ft by 70-ft absorber for extraction of all butanes and heavier, and 57 per cent of the available propane. The absorbent, 42-44 water white kerosine is pumped to the absorber at a rate of 32 gal per 1000 cu ft. Dry residue gas flows through a 10-in. line from the top of the absorber to the intake scrubbers of the third stage compressors where the pressure is raised to that carried by the receiving gas transmission system for distribution as industrial and domestic fuel.

Efficient Stripping

The rich oil flows at the operating pressure of 195 psig through a battery of shell and tube interchangers, handling hot lean oil through one side and the cold rich oil on the other to raise the temperature of the cold oil to around 300 F. The rich oil is released into a 6-ft by 42-ft stripper column, which removes methane and ethane overhead. Temperature at the top of the stripper is maintained at 250 F by the introduction of a stream of cold rich oil. To expedite stripping of light uncondensable fractions from the rich oil, a recording temperature controller automatically allows a quantity of hot oil from the second stage fractionator or still to enter the stripper so that it may be operated at 325 F. This stream also supplies

FIG. 2. Flow chart of Velma gasoline plant. Note use of direct-fired heaters.





Four of the eleven United Type ES Pumps recently installed in Skelly Oil Company's Velma, Oklahoma natural gasoline plant.

To meet exacting requirements in the handling of 550° F. absorption oil, rich absorption oil, and light hydrocarbons, eleven United Type ES Pumps are employed by Skelly Oil Company's modern Velma, Oklahoma natural gasoline plant.

These are representative of the thousands of United Type ES Pumps now in service throughout the world. Some have been in constant operation for over 15 years. Simple design characteristics provide high efficiency and dependability at relatively low initial cost. Sizes from 1½" to 10" are available to meet a wide range of requirements. United's unique engineering and production facilities make it possible to provide design and metallurgical modifications to fit exact job requirements. For instance, Model ES Pumps are now handling liquids from sub-zero to 800° F.—discharge pressures up to 700 psi—metallurgy ranging from cast iron to pure nickel. And every United Centrifugal Pump is backed by the experience of over a quarter of a century of specialized engineering service to the petroleum industry. Contact your nearest United Office today for complete details.

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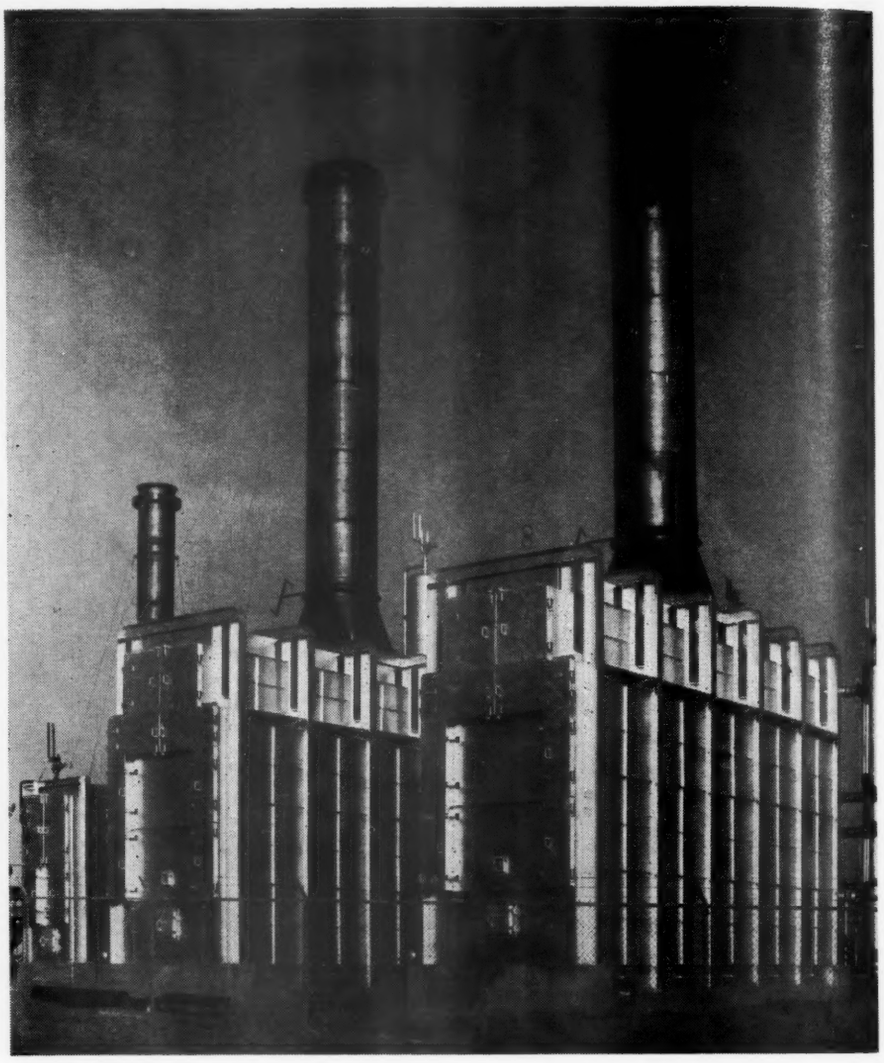
FIG. 3. Two direct-fired up-flow heaters supply the main operating heat requirements for the plant.



stripping vapor as the kerosine from the low pressure still is at such a temperature that a portion is in the vapor stage. The drop in pressure from absorber at 195 psig to the stripper at 70 psig is adequate for the release of all the undesirable fractions and the column functions actually as a demethanizer-deethanizer unit. Overhead vapors from the rich oil stripper are released through adequate controls from 70 psig to 45 psig to a reabsorber, which functions in the same manner as a vapor recovery column does in a refinery. All the vapors from make tanks in subsequent facilities of the gasoline plant pass likewise to the reabsorber to recover any marketable fractions that might escape with dry uncondensed vapors. The reabsorber is 3 ft by 70 ft and is supplied with a stream of cold lean absorption oil that upon release from the base of the column is passed through exchangers, then added to the rich oil from the stripper before entering the heaters. Pumps deliver this rich oil through a 6-in. line to two 30,000,000 Btu direct-fired Born Up-Flo heaters, equipped with John Zink burners, operating in

FIG. 4. Battery of 600 hp, gas engine-driven compressors, which handle all gas to the plant.

another important project

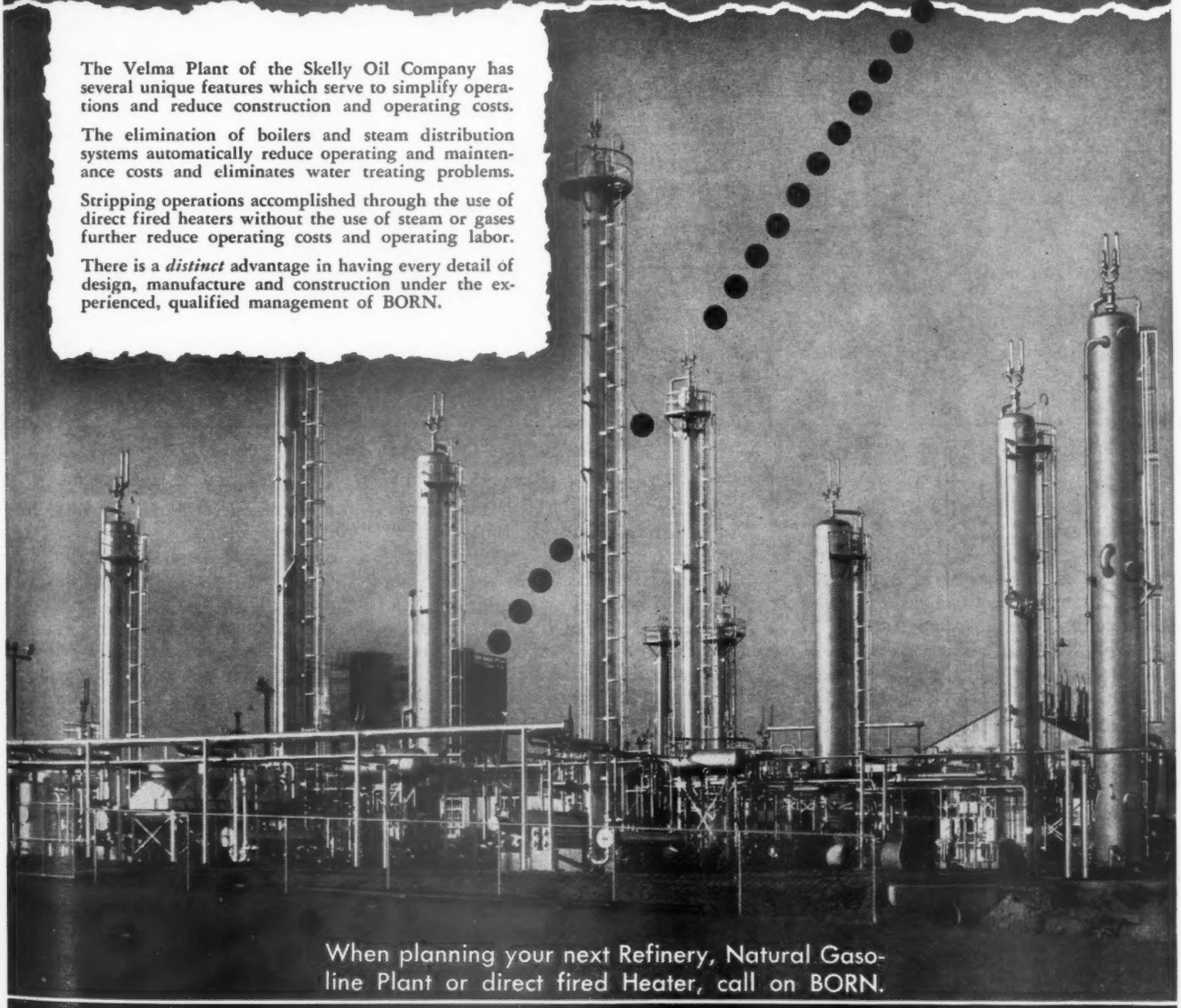
Designed AND Constructed BY BORN

The Velma Plant of the Skelly Oil Company has several unique features which serve to simplify operations and reduce construction and operating costs.

The elimination of boilers and steam distribution systems automatically reduce operating and maintenance costs and eliminates water treating problems.

Stripping operations accomplished through the use of direct fired heaters without the use of steam or gases further reduce operating costs and operating labor.

There is a *distinct* advantage in having every detail of design, manufacture and construction under the experienced, qualified management of BORN.



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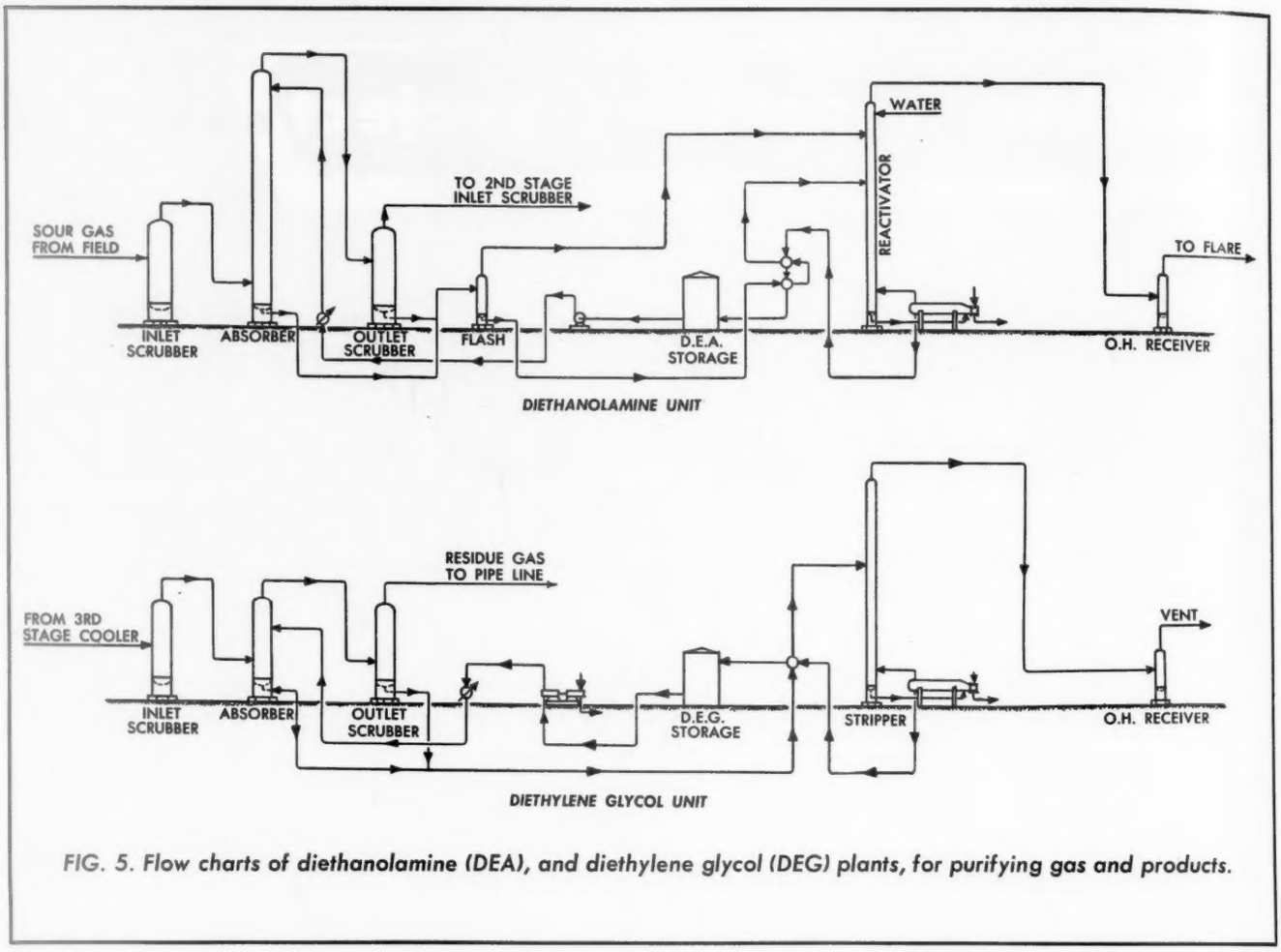


FIG. 5. Flow charts of diethanolamine (DEA), and diethylene glycol (DEG) plants, for purifying gas and products.

parallel. These heaters have an efficiency of over 70 per cent and raise the temperature of the rich oil to 495 F, at which temperature the rich absorption oil is flashed in a primary still, 4 ft by 40 ft, to release as much of the absorbed gasoline fraction as possible at an operating pressure of 105 psig. The top of the primary still is held at a temperature of 208 F for end point control of the overhead product. Partially stripped rich oil at a pressure of 105 psig flows at process pressure through adequate controls to the secondary, or low pressure still for final complete stripping of gasoline from the absorption oil. The make from the low pressure column is pumped into the vapor stream from the high pressure column assisting in condensing the lighter components that would otherwise be lost.

Oil Heat Medium

Instead of using steam as a stripping medium as employed in conventional gasoline plants, the Velma plant has a direct-fired heater supplying heat to reboilers. Recirculation permits control of the reboiler oil temperature. The heater supplying heat to the reboiler circuits has a capacity of 10,000,000 Btu per hr, which vaporizes a predetermined quantity of absorption oil, which acts as a stripping medium to release the gasoline fractions contained in the absorption oil. Condensate from the column is refluxed to maintain a temperature of 216 F at the top of the column. The low pressure still therefore makes end point natural gasoline overhead. Overhead product is passed through aerial coolers for primary treatment and through a shell and tube, water-cooled aftercooler to complete condensation. The efficiency of the aerial coolers is high enough that water is cut off during most of the year. All overhead product is handled with two pumps, one controlled by a column top recording temperature controller to handle reflux and the other working on liquid level to pump the condensate from the make tank to the vapor stream coming from the top of the primary, or high pressure still. This two-stage stripping permits the removal of all desirable hydrocarbons from the rich oil without the use of excessive temperatures and by recombining the low pressure make with the high pressure still vapors, permits the recovery of the more volatile components without the use of recompressors or other recycling operations. It also recombines the total make so that one product is available for stabilization and all further fractionation.

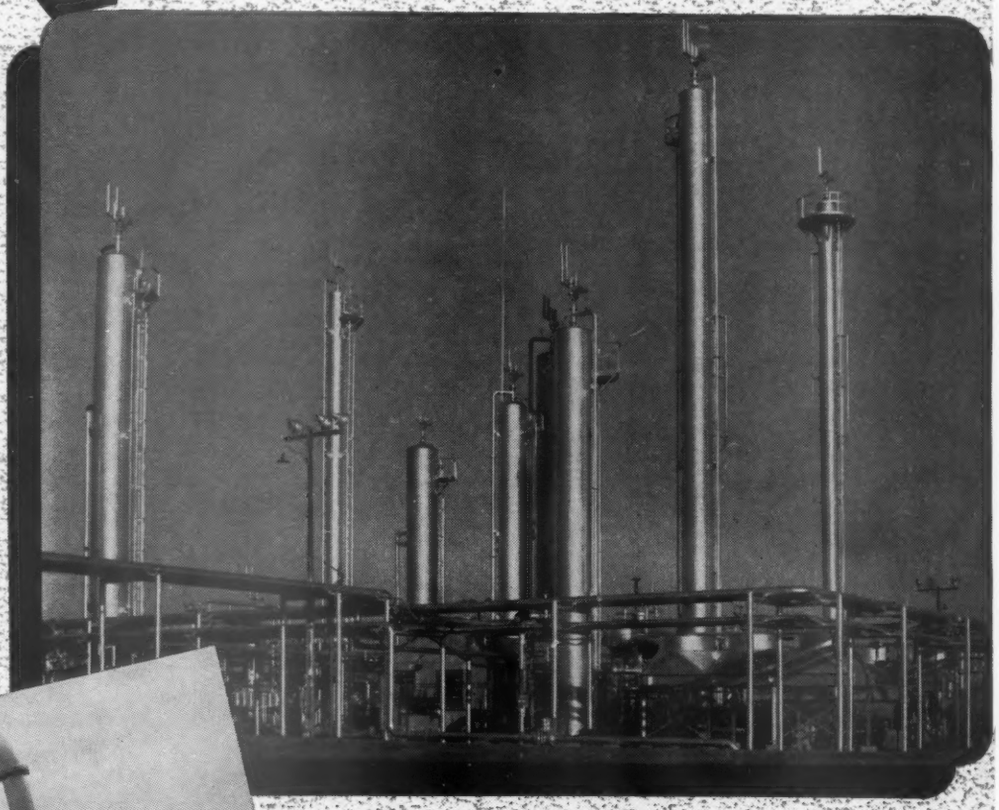
Condensate from both stills is removed from the high pressure make tank with a Worthington Hi-Vol reciprocating pump for processing into different grades of natural gasoline. The stabilizer is 4 ft by 80 ft containing 30 trays where the bottom product may be any grade of commercial natural gasoline, but currently is fractionated to a 12-lb RVP product. Bottoms flow through liquid level control and exchangers to water cooled shell and tube units and finally to storage. The base of the fractionator has a conventional design reboiler that is heated with a stream of hot absorption oil from the base of the secondary, or low pressure still, so that again, steam is not necessary for the plant's operation.

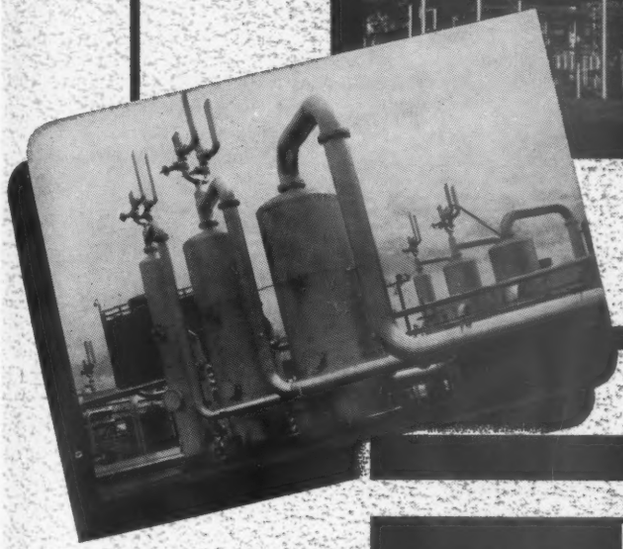
Use Aerial Coolers

The stabilizer overhead containing all the gasoline fractions not desired for 12-lb RVP gasoline is condensed with aerial coolers followed by shell and tube water aftercoolers. The liquid condensate at 235 psig accumulates in a 4 ft by 10 ft horizontal reflux drum from which it is pumped to a

TULSA TYPE

BUILT *Right*





WE SUPPLIED MOST OF THE FOLLOWING EQUIPMENT USED IN THE VELMA GASOLINE PLANT OF THE SKELLY OIL COMPANY:

- FRACTIONATING COLUMNS
- ABSORBERS
- REACTIVATOR
- REABSORBER
- STILLS
- SCRUBBERS
- STRUCTURAL STEEL
- STRIPPERS
- VARIOUS PRESSURE VESSELS

FLINT STEEL CORPORATION

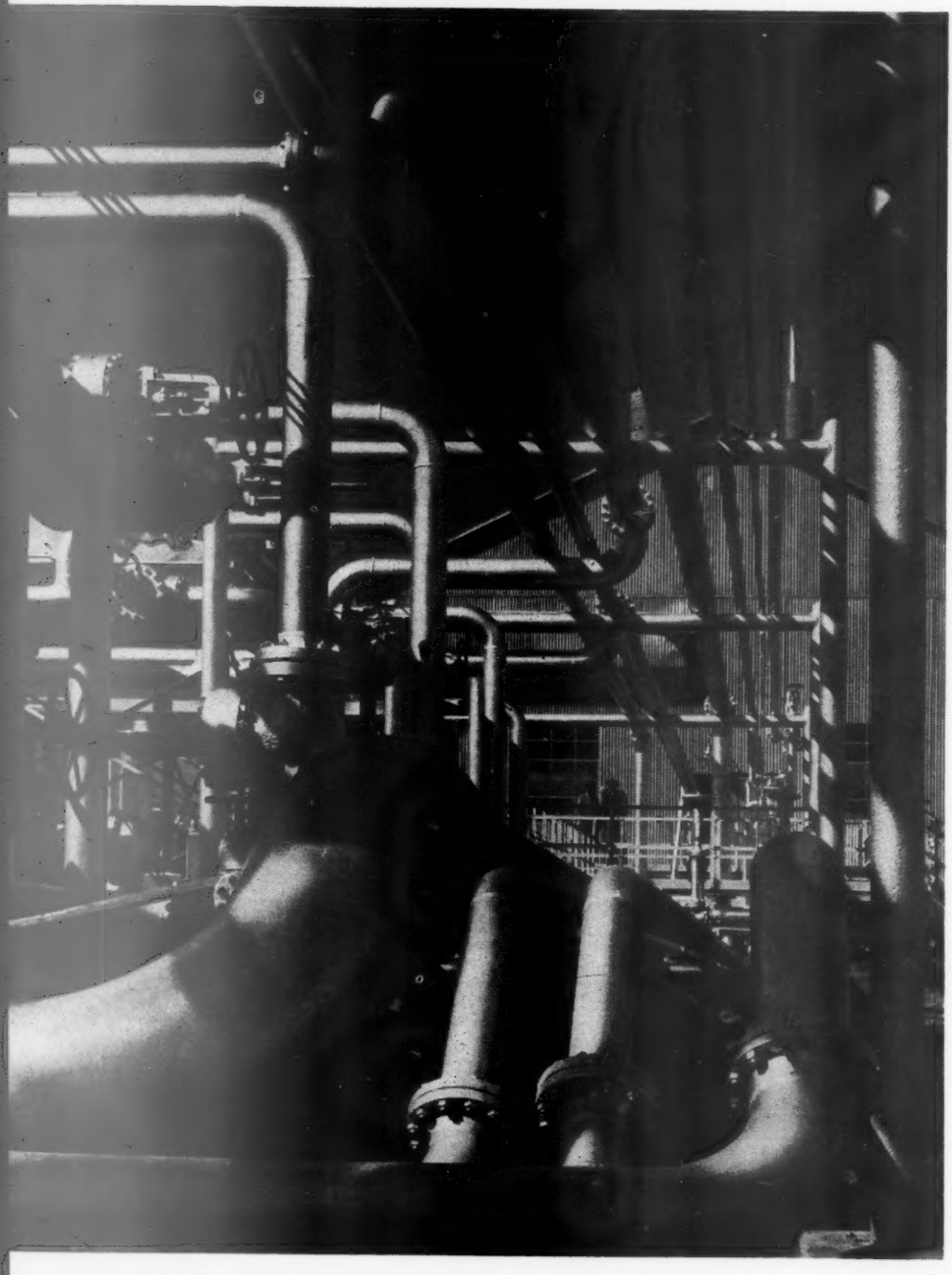
TULSA, OKLAHOMA

LPG column, 2 ft 6 in. by 80 ft, containing 30 trays. This tower is operated at 485 psig with a conventional type reboiler on the base. Here again, hot absorption oil from the bottom of the high temperature, low pressure still is employed to maintain the required temperature for effective LPG fractionation. Any grade of LPG can be produced readily from the base of this column by adjusting the controls. Overhead is partially condensed to supply an adequate quantity of liquid product for reflux control, while excess vapors flow into the fuel lines leading to the direct-fired process heaters.

The most outstanding feature of this Velma plant is that all heat used in the plant and for oil processing is obtained from the three direct-fired Born Up-Flo heaters. Two of these units, operating in parallel, are used to raise the temperature of the rich oil for stripping and fractionation, while the third supplies heat for vaporizing absorption oil as a stripping medium for reboiler circuits, for radiators in the control room, and for heating residue gas, which is used to operate reciprocating product and process pumps.

The reciprocating high pressure pumps handling liquids take their power from the residue in the 195-lb line from the absorber and operate both as product pumps and pressure reducers for fuel required at low pressure. To prevent icing of the high pressure reflux and process units in the DEA and DEG plants, the gas piping handling the power gas is laid snugly against hot oil lines and insulated so that the gas, when it enters the power cylinders, can be handled with gas engine lubricating oil without danger of coagulation and subtemperature icing.

FIG. 6. Plant piping, valves, etc., are open to observation and to workmen throughout the plant.



Low Water Consumption

Another feature of the plant is the low consumption of cooling water. Water in the Velma field is scarce and has a high mineral content requiring intricate treatment. Radiator type engine jacket water coolers are used throughout the plant on a closed system to prevent loss of jacket water. The water in the jacket cooling system is a steam condensate, prepared prior to the starting of the plant and conditioned with an inhibitor to prevent rust and corrosion. Each jacket water cooler is arranged in a rectangle so that equal areas are presented on all sides. Air is drawn through the fins by an airplane prop-type fan with a variable speed device to control water temperature and conserve horse power. The engine jacket make-up water is produced, as required, with a waste heat steam generator or distillation unit set into the vapor line on the absorption oil purifying plant. This unit operates as a kerosine fractionator and purifies continuously part of the outlet stream from the direct-fired heater supplying heat to the base of the low pressure still.

Process cooling is accomplished with aerial type coolers engineered for specific operation. The major cooling of absorption oil is obtained in a large battery of these units, which are adequate for most of the year but are supplemented with water shell and tube units for use during periods of high atmospheric temperature. Water for aftercooling is prepared by zeolite treating well water produced at the plant and cooled in a 3000 gpm Fluor induced draft tower. On product coolers, the units are designed with three separate fans in shrouds, or stacks powered by motors with high and low speed windings so that half speed can be used, one or more cut out, or shut down altogether when the atmosphere is below freezing. All this can be controlled by the operator from a central control.

Prefabricated Lines

To facilitate the construction of the plant and to eliminate a large amount of welding at the site, all piping for

headers, laterals, and process lines were prefabricated. This method relieved congestion in the construction area and greatly simplified installation. There is no underground piping so that the possibility of corrosion is reduced to a minimum, and plant inspections can be made with ease.

Unlike conventional natural gasoline plants this plant closely resembles a highly specialized oil refinery and is operated and controlled from a central control room equipped with instruments that indicate and record all operating conditions so that all changes can be made from one point. The complicated instrument panel was prefabricated and shipped to the plant site as a complete unit. Installation of the panel was facilitated by proper grouping of headers and junction boxes. Nelson Electric assembled the panel boards at their Tulsa plant.

The design, purchasing, and construction of the entire project were carried out by the Born Engineering Company of Tulsa, Oklahoma, in collaboration with J. W. Vaiden, vice president, G. E. Canaday, gasoline department manager, E. J. Sour, purchasing department, J. Y. Haslam, chief engineer, and other members of the Skelly engineering organization.

H_2S Removal

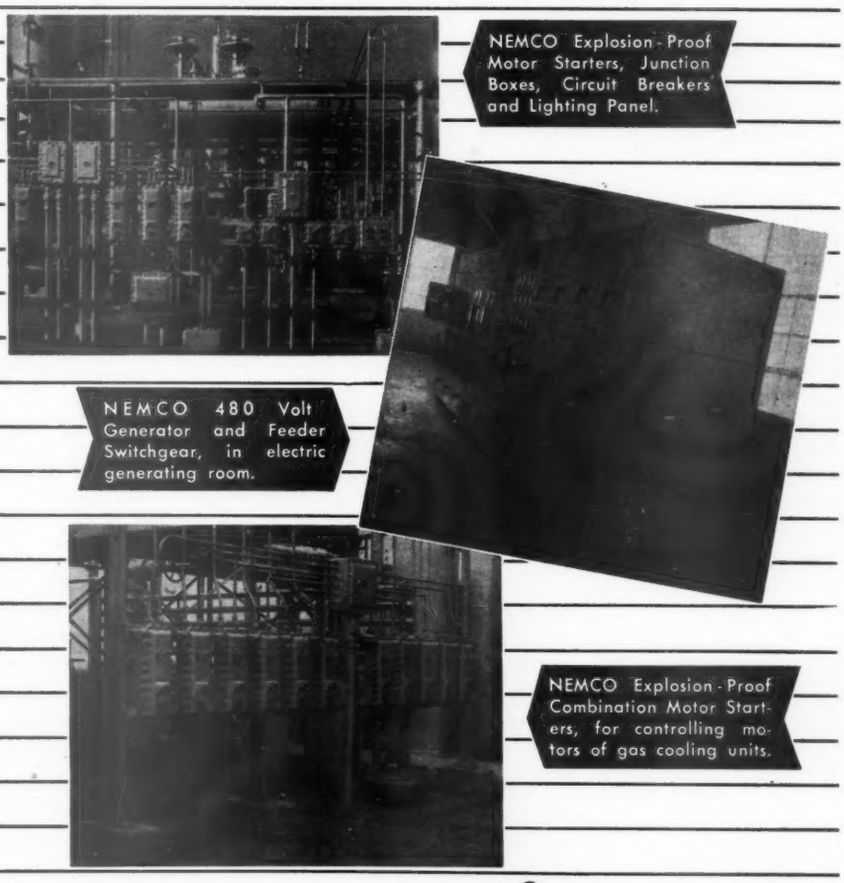
Oil and gas streams produced from the various sands in the Velma, Oklahoma, field are as varied in composition as the areas from which they are obtained, therefore because of contamination by hydrogen sulphide, 6,000,000 cu ft of the gas passing through the modern plant recently constructed must be treated to reduce the H_2S content. In order to extract essentially all the H_2S, a diethanolamine unit that operates in conjunction with the natural gasoline extraction plant was installed. The sour gas is produced with oil flowing at pressures that permit piping the gas through a gathering system that is independent of the vacuum lines. The sour gas is received at the plant inlet scrubbers at a pressure that can be equalized with the discharge from the first stage compressors handling sweet gas from other sections of the field.

The sour gas conditioning unit is protected by a 5-ft by 16-ft separator, equipped with automatic instruments that warn plant operators of any appreciable amount of oil that may collect in the vessel, thus preventing any liquid in the gas from carrying over with the gas to the absorber. An 8-in. line carries the sour gas through a pressure control valve operated by a pressure controller on the second stage compressor discharge so that the pressure on the sour gas is equalized with the 24,000,000 cu ft of sweet gas processed in first stage compression. Immediately after flowing through the pressure controller, the gas enters the 4-ft by 51-ft DEA absorber equipped with 22 bubble plates and fitted with an inlet below the bottom tray. The treated gas leaves the absorber at the top through an 8-in. line connected to a 5-ft by 16-ft knock-out drum having a mist extractor in the upper section to prevent loss of DEA. From the knock-out drum, the gas, which originally contained an average of 200 grains of hydrogen suphide and perhaps a trace of carbon dioxide, mixes with the sweet gas for processing without harmful effects on gasoline plant equipment or finished products.

Diethanolamine is pumped at a controlled rate through a 3-in. line to the top plate of the extracting column, or absorber, for conventional countercurrent flow to the base of the column. Withdrawn from the base of the absorber through liquid level controls and valves at 40/45 psig, the degraded diethanolamine (DEA) is flashed in a 2-ft by 8-ft drum to release entrained or absorbed vapors to lessen the overall load on the exchangers and DEA reactivator. A level is maintained in

NELSON *control equipment....*

is "part of the picture" at Skelly Oil Company's New Gasoline Plant at Velma, Oklahoma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NEMCO Explosion-Proof Combination Motor Starters, for controlling motors of gas cooling units.

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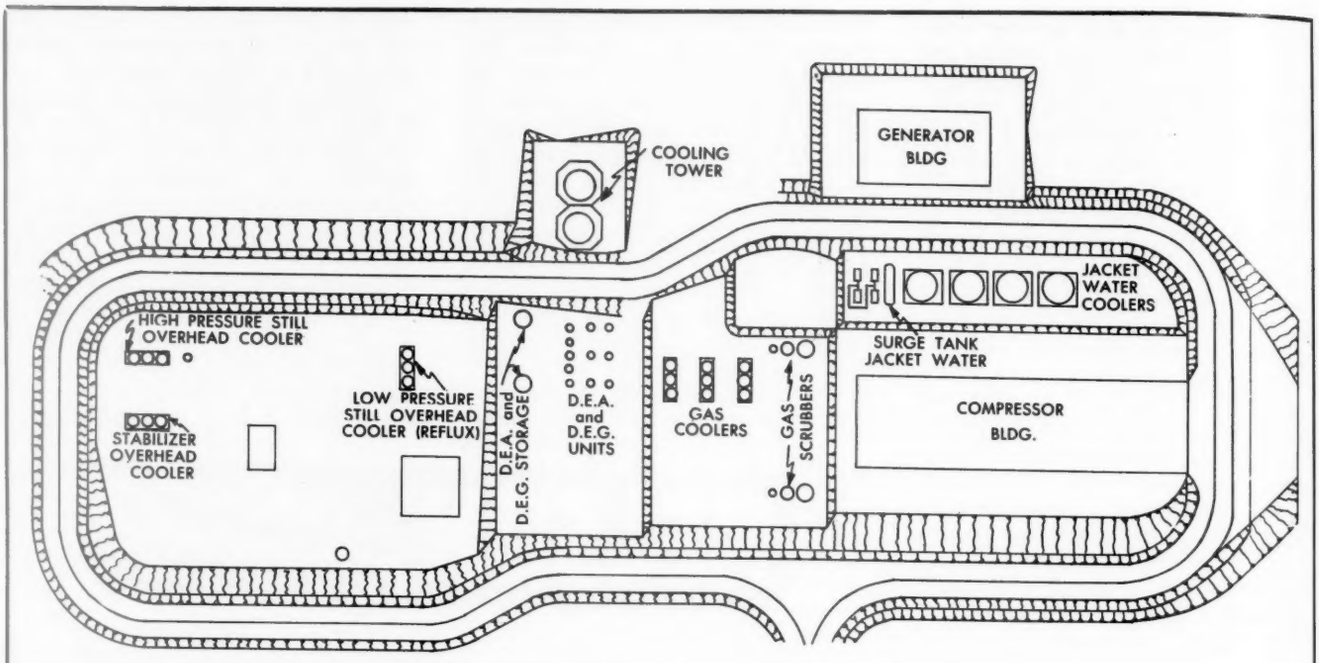

FIG. 7. Simplified grading and ground plan allows for expansion, additions, and repairs to equipment.

the flash drum to smooth out the flow of liquid feed to reactivator bottoms exchangers and into the column. Feed to the reactivators may be introduced at either of two points, on the fifth or on the ninth plate, numbering from the top of the column. The reactivator is 2 ft by 46 ft, contains 20 trays and is equipped with a conventional type reboiler but, instead of steam, heat is supplied by a stream of hot absorption oil obtained from the direct-fired heaters.

Reactivated DEA flows from the base of the reactivator through a 3-in. line to the bank of bottoms-to-charge exchangers, and thence to an 8-ft by 12-ft surge or storage tank without cooling. Instead of reducing the temperature of the DEA at the outlet of the interchangers, operating temperatures are obtained with shell and tube coolers in the absorber charge line so that optimum operating conditions can be maintained, regardless of the time lag or interval between the discharge of the liquid from the base of the reactivator and the period when the charge pumps deliver the DEA to the absorber.

When laying out the ground plan of the gasoline plant at Velma, Oklahoma, cognizance was taken of the fact that, during the life of the operating equipment, some columns, exchangers, piping, and the like would eventually need to be reconditioned or replaced with new designs, or that the capacity of the plant would require enlargement. Enlargement was the prime factor governing the ground plan and the currently installed columns and other machinery were placed on foundations in such a position that identical equipment throughout the plant could be easily installed without disturbing the operation.

Therefore, no single column, tower, or pump is placed at a distance greater than 100 ft from an access road. This road is laid out in an elliptical shape with the ingress and egress point on the north side convenient to the nearby paved highway. This roadway encloses all the operating equipment except the Fluor water-cooling tower, the storage tanks, and the Born direct-fired heaters. The east section of the plant is considered static, so far as extensions are concerned, as space was reserved at each major unit to erect and install duplicate units. On the west end, the engine room containing the generating equipment and the compressors may be extended to a greater length, which will eventually require that the west segment of the roadway be moved, but not so as to disturb access to any of the equipment.

* * *

Radioactive Piston Rings Used for Tests

The California Research Corporation, a subsidiary of the Standard Oil Company of California, and the Isotopes Division of the Atomic Energy Commission said in a joint announcement that the corporation's research staff is successfully using radioactive piston rings to test the effect of fuels and lubricants on engine wear. With radioactive rings in an engine, the amount of wear can be measured by an extremely simple method, yet one of such accuracy that as little as one millionth of an ounce of metal worn from the rings can be detected.

The piston rings are irradiated in the chain-reacting pile as one of the services being rendered to American industry by the Atomic Energy Commission and the Oak Ridge Laboratory, operated for the commission by Carbide and Carbon Chemicals Corporation.

In another experiment, radioactive isotopes are being used to study methods of producing better petroleum fuels. The chemist labels a gasoline molecule by substituting a radioactive carbon atom for an ordinary carbon atom. The exact fate of the hydrocarbon molecule as it passes through refinery operations can then be studied with a Geiger counter.

Since August, 1946, when the first shipment of radioisotopes was made from Oak Ridge National Laboratory, 173 shipments have been made to industrial concerns for experimental work. In addition, 4369 shipments have gone for biological, medical, and agricultural experiments and 19 foreign countries have received 355 shipments for experimental work.

Solve Fuel Problems by Increasing Power Efficiency, Engineers Say

ARCH L. FOSTER†

INCREASING the efficiency of our fuel consumption — more miles per gallon—plus development of additional sources of fuels and power energy are the two principles by which we can assure adequate supplies of fuel and power and thus offset any reduction in petroleum reserves, R. J. S. Pigott, retiring president, Society of Automotive Engineers, told that body, meeting in annual conclave in Detroit in January. With 5 per cent overall efficiency for automotive power equipment—the same week Holaday said 6 per cent—and for steam locomotives, and only 20 per cent for utilities power generation, the situation offers large opportunity for improvement.

One large possibility is that of converting all possible means of power generation to the use of the less mobile solid fuels, retaining liquid fuels for those uses where liquid mobility is indispensable, Pigott indicated. This means using coal for all stationary power generation. It means using sun power collection when possible, a not generally applicable effort. Wind and wave and tide energy can be applied in some cases, but the intermittent nature of this source involves satisfactory and efficiency means for storing energy until needed, to bridge nonproductive periods. Little can be expected from these sources for most of the world's needs, Pigott said.

One of the greater sources of electric stationary-generated power is hydroelectric plants, of which a total power of 50,000,000 kw may be produced in this country; only 10,000,000 of these possible kilowatts have been built. Since water power is advantageous and efficient only at high load factor, this advantage must be available before the excessive installation cost of hydroelectric units can be made economical for general operation.

Synthetic fuel processes are too wasteful of the energy stored in the raw materials, Pigott pointed out. Forty to fifty per cent of the energy in coal or gas is used up when making liquid fuel via the Fischer-Tropsch reaction, and the cost of this synthesis, aside from the enegry waste, is far higher than that for making the same products from petroleum. As time goes on, both these drawbacks, low conversion ratios and high operating costs will be reduced, making these processes more nearly competitive with petroleum, especially as prices rise for petroleum products.

Recent pessimistic estimates of the expectable life of our petroleum reserves are erroneous and misleading, the SAE president said, because the method of estimation is oversimplified. It takes no account of unproved reserves, or of new but as yet unheralded discoveries or of improved recovery in old, well known fields. Already in the last generation the recovery efficiency has risen from the order of 10-20 per cent of the total oil in formations to 60-70 per cent. Coal and oil shale are our best bets for fuel supplies to supplement petroleum; petroleum in sight and probable additions indicate a minimum life of 20-25 years, a maximum of 50 years, "and one cannot pin it down any closer."

Improvement of internal combustion engine efficiency may be made in a number of ways; one of the best is the use of a transmission that will keep the engine at its most efficient speed, 1500-1800 rpm, at which engines are more efficient at part load than at higher or lower speeds. Another is the use of two-stage compression, that is, a supercharger plus the engine cylinder-piston combination, to run present types of engines, with present or slightly raised compression ratios, on fuels of current octane ratings—85-92 Research—to obtain 35-40 per cent efficiency increase. Subsidiary advantages are obtained by these methods and often double the theoretical advantage found by the engineer. A two-stage expansion of the combustion gases, that is a blower turned by the exhaust gases from the cylinder and geared to engine or drive mechanism, will obtain the economics of greater expansion ratio just as a supercharger gains the advantage of greater compression pressure or ratio.

The cumulative total of efficiency advantages obtainable by several improvements that can be made by automotive and fuel-lubrication engineers in automotive equipment is near 100 per cent at the probable minimum, says Dr. W. S. James, ex-SAE president and well known automotive authority of the Fram Corporation. With the price of motor fuel averaging 24 cents per gallon, and with 15 miles per gallon being the approximate average return, fuel costs average 32 per cent of the total cost of operating automotive equipment. U. S. motorists use 1200 gal of motor fuel per second, James stated. A decrease of even one per cent in this consumption rate will save the public $90,000,000 annually; or will give nearly 6 billion car-miles more for the same price, James calculated.

The torque converter appears to be the "nearly 100 per cent efficient" piece of equipment to improve overall efficiency of the automotive engine, says O. K. Kelley of General Motors Corporation. The Hydra-matic and Dynaflow types of torque converters are the best approaches to the ideal unit so far, Kelley said, and their introduction shows a trend to the development of an automatic drive fitted for automobile operation. In the torque converter, with nothing to wear or get out of order, "there is no way they (the manufacturer) can spoil the torque converter's smoothness."

A peep behind the curtain at possible future automotive passenger car power plants was given at the Detroit meeting by S. D. Hage of Boeing Airplane Company, who reported on an experimental gas turbine weighing 150 lb, which "turns up" 200 brake hp. This new super turbine develops rated power easily in 15 sec after starting cold, accelerates from idling to

†Refining and Gas Processing Editor.

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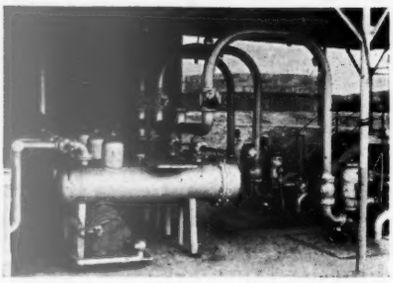

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R. J. S. Pigott is the outgoing (1948) president of the Society of Automotive Engineers, the largest and most aggressive organization in its field in the world. He is director of engineering research for Gulf Research and Development Company, is known widely for his contributions to engineering advances in automotive power plants and their fuels and lubricants, as well as for his work in other mechanical engineering lines.

W. M. Holaday is research director for Socony-Vacuum Oil Company's laboratories and one of the foremost leaders in oil and automotive technical circles. Member of many scientific and technical organizations, he has long been a strong proponent for petroleum conservation by using existing materials and products to their maximum efficiency, in preference to producing better materials which are not utilized efficiently.

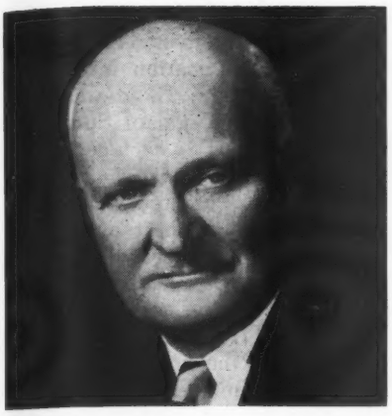
full speed in 5 seconds. It cannot be stalled, Hage says, and is "relatively economical in fuel consumption."

This turbine is made up of two constant-pressure burners, a single-stage centrifugal compressor with two outlets, a compressor-driving turbine. The primary stage runs 36,000 rpm, drives the accessories. The power-output, or secondary stage is a second turbine of 24,000 rpm, with a 9.6:1 reduction gear pulling the speed down to 2500 rpm. Admittedly the turbine has a number of disadvantages such as tremendous air consumption, high fuel consumption when idling, and one problem defying solution, that of compressor inlet noise. In spite of unsolved problems, Hage believes the turbine may offer a better power plant for many uses than anything else now in sight.

Numerous new developments and outstanding accomplishments were reported before the January SAE meeting. The automotive diesel engine, two-cycle, high compression, is proving to be more economical by far than the gasoline engine, especially in city buses and similar applications. An annual saving of $500 per bus is obtained by the use of the best diesel engines, with the fuels the same price, as compared to gasoline engines, E. N. Hatch of the New York Transit System reported. Diesel engines must have careful maintenance to avoid too much smoke and noise if they are to be satisfactory to the public, Hatch said. Little difference in cost of inspections is found between the two types of engines when good preventive maintenance methods are employed.

Wide-cut, 130 F flash-point diesel fuels are entirely safe for use in railroad diesel engines, A. B. Crampton, S. H. Hulse, and N. H. Rickles of Standard Oil Development Company report, after experience of 15 months with this type of fuel in engines operated by the New York, Ontario, and Western Railway. This flash temperature is safe for operation at 143 F, a temperature unlikely to be found in service, unless maladjustment of equipment occurs. Specifications for diesel fuels are maintained needlessly high, these investigators stated, requiring additional processing equipment and thus added cost for fuel.

High quality diesel fuel fractions should be saved wherever possible, by diverting low cetane number to heating and similar uses where the specifications are not critical as is the case with Diesel fuels. For example, a survey of users' recommendations and specifications for diesel fuels shows



W. S. JAMES, vice president in charge of engineering of Fram Corporation, is one of the most widely known of the engineering leaders in the automotive and oil industries. An ex-president of the SAE, James' most outstanding recent contribution to the nation is the direction of the development of the Weasel, an amphibious tractor-type cargo carrier, which was used widely in both war theaters. Granted the BS degree in mechanical engineering from George Washington University in 1917, he became chief of the power plant section of the U. S. Bureau of Standards in 1920, worked with engineering development with Hupp Motor Company and Associated Oil Company before joining Studebaker Corporation, of which he became chief engineer in 1936. Ford selected him to head Ford's research as director in 1945, from which job he went recently to Fram, the widely known builder of air, gasoline, and oil filters. James has been an active leader in the Coordinating Research Council, National Advisory Committee for Aeronautics, the American Society for Testing Materials, and other engineering and scientific bodies.

that flash is set at about 150 F, when 120 F would be quite satisfactory. Cetane number specifications average about 45, sometimes as high as 50, a rating that may not be necessary to good operation of most diesels. The low specification of 0.5 per cent sulphur may not be needed in many applications, these researchers believe. To illustrate the possibilities for increase in diesel fuel supplies obtainable from crude by change in specifications, one refiner shows that 45 per cent more 50 cetane number fuel can be recovered from his crude if the flash is lowered to 120 F and sulphur content is made 1.0 per cent maximum. Drop cetane number to 35 minimum and that refiner can supply 80 per cent more fuel of 150 F flash and 0.5 per cent sulphur. Reduce flash to 120 F, sulphur to 1.0 per cent, and cetane number to 35 minimum and this refiner can supply 220 per cent more diesel fuel.

* * *

Aviation Gasolines Show Uniform Qualities

A remarkable uniformity of properties and inspection data is found in the two surveys of aviation fuels made in 1948 by the U. S. Bureau of Mines. This uniformity is more outstanding in the higher grades, as is to be expected. It is less expensive for the supplier to "give away" a few octane numbers in grade 80 fuels or 91-98 fuels than in the superfuels of grade 115-145, etc., and this fact is reflected in the results shown.

Comparing January and July 1948 surveys, the octane number range in July was from 80 to 88.1, while for January it was only from 79.7 to 81. Performance numbers or rich mixture ratings were not reported on this lowest aviation grade.

For grade 91-98, in January the octane range was from 90.8 to 96.6; for July it was even wider, being from 91.0 to above 100, or isooctane plus 0.02 ml TEL per gallon. The two highest grades reported show relatively little variation from sample to sample. The 100-130 grade ranged from 100 to isooctane plus 0.40 ml TEL (lean mixture) in January, for July 99.6 to isooctane plus 0.5 ml TEL. The rich mixture performance numbers of this grade varied from 129.6 to 133.0 in July samples; essentially the same values, well within experimental error, were found from the January survey.

Grade 115-145 samples also showed close values in rich mixtures, ranging from performance numbers of 145.14 to 147.1 in January, essentially the same in July. Strangely, a wider range appears in lean mixture performance numbers, 115.1 to 125.7 in January, 115.0 to 121.0 in July; this indicates variation in the performance characteristics of these fuels under the different conditions of tests.

Sulphur contents of the various samples and grades are extremely uniform, and relatively low. The range in grade 80 fuels was 0.004 per cent to 0.03 per cent, January, 1948; 0.005 to 0.031 per cent in July. Sulphur in the other grades was also low, the lowest value reported being 0.002 per cent (91-98), the highest 0.044 per cent (100-130).

Only small amounts of tetraethyllead were used in grade 80 fuels, ranging from none in a majority of samples to a maximum of 0.47 ml per gallon, with most fuels showing only 0.10 to 0.16 ml per gallon. The highest grades showed also a uniformity of TEL content, the narrowest range being shown in 115-145 grade, 4.28 ml to 4.62 ml per gallon. The widest ranges were in the 91-98 grades, which showed 0.45 ml to 4.57 ml in January samples, and 0.77 ml to 4.43 ml per gallon in July.

As is expectable, Reid vapor pressure came bang up against the 7 lb maximum limit, in all grades; practically no samples below 5.5 lb Reid, three showing 4.5, 4.8 and 5.1 lb. The data referred to so far are taken from reports of tests by manufacturers, results reported to the Bureau.

The Bureau in each survey carried out several less commonly made tests on one-gallon samples of each fuel obtained, determining distillation range, (ASTM D2-6-40); vapor pressure by CRC procedure; density, by weight at 60 F and 20 C, and viscosity, kinematic, at 70 F with Cannon-Fenske master-type viscometers. A definite trend toward less spread between endpoint temperatures of different samples appeared as the grade of fuel is raised. Range of temperature (endpoint) is between 339 and 207 F in grade 80 or a difference of 132 F. In the 91-98 grade samples the range was from 339 to 232 or 107 F. Grade 100-130 varied endpoints from 356 to 252, difference of 104 F, while the highest grade showed endpoints from 337 to 244 F or 93 degrees range. Reid vapor pressures in July grade 115-145 samples showed an outstanding conservation in range, varying from the lowest of 6.03 lb to a maximum of 6.53 lb, a variation of only ½ lb.

Ranges of aviation fuel qualities, January and July, 1948.

Fuel	Octane number		Reid vapor pressure, lb	Sulfur, per cent	TEL, ml per gal
Grade 80					
Jan., 1948	79.7–81.0		5.5–7.0	0.004–0.030	None–0.45
July, 1948	80.0–88.1		4.5–7.0	0.005–0.031	None–0.47
	Octane number				
Grade 91–98	Lean Mix.	Rich Mix.			
Jan., 1948	90.8–96.6	97.6–100.0	4.8–7.0	0.002–0.040	0.45–4.57
July, 1948	91.0–Iso. 0.02	97.6–Iso. 0.04	5.7–7.0	0.005–0.040	0.77–4.43
	Octane number	Performance number			
Grade 100–130	Lean	Rich			
Jan., 1948	100–Iso. 0.4	129.6–132.8	5.5–6.9	0.003–0.040	2.39–4.60
July, 1948	99.6–Iso. 0.5	129.6–133.0	5.1–7.0	0.003–0.044	2.24–4.62
	Performance number				
Grade 115–145	Lean	Rich			
Jan., 1948	115.1–125.7	145.14–147.1	5.6–7.0	0.01 –0.040	4.41–4.60
July, 1948	115.0–121.0	145.50–147.0	5.5–6.9	0.008–0.030	4.28–4.62

NEWS

Project Director for Houdry

Heinz Heinemann, former research chemist and research supervisor with Attapulgus Clay Company, Camden, New Jersey, has joined the staff of Houdry Process Corporation as a project director with headquarters

Heinz Heinemann

at the Houdry Laboratories, near Marcus Hook, Pennsylvania.

He received his formal education at the University of Berlin and Technische Hochschule, Berlin, Germany; his doctorate was received at the University of Basle, Switzerland, in 1937.

After a year's research work on synthetic fuels in Germany, Dr. Heinemann came to the U. S. as chief research chemist for the Rodessa Oil and Refining Corporation, Shreveport, Louisiana, in 1938. In 1940 he became research chemist for Danciger Oil and Refining Inc., Tulsa, Oklahoma, operating at the company's Pampa, Texas refinery. He became a research-fellow at Carnegie Institute of Technology, in 1941, serving as assistant to the late Dr. Ernst Berl.

German Units Rebuilding

Two large hydrogenation plants are being rebuilt, at Wesseling and at Gelsenberg, Germany, under authorization by British and U. S. officials. Three oil companies will operate the plants, under agreements with German companies owning the plants originally. These plants will process about 16,000 bbl per day of heavy residuum. From Kuwait and Saudi Arabia, crude will be imported under the Marshall Plan and processed in distillation units, to yield the heavy residues that will be subjected to high pressure hydrogenation. The units are expected to be in operation by April, 1949, and will supply about half the required petroleum products in the western zones of Germany.

Aerosol Fogging

Sovacide F, a petroleum product developed by the Socony-Vacuum Oil Company, Inc., for outdoor aerosol fogging, will be used again in 1949 in an expanded blackfly-control project in an Adirondack resort region in Herkimer County, New York, the company announced recently. Blackflies are a recurring problem each spring in many parts of the Adirondack mountains and elsewhere.

Sovacide F and a Bell Aircraft Company helicopter were used for the first time in the area last spring, together with ground-operated TIFA equipment produced by the Todd Shipyards Company.

In the original operation, Socony-Vacuum reported, a 4000-acre tract was fogged by the helicopter with a Sovacide F solution containing 15 per cent of DDT. In 1949, the area to be treated will be expanded to 8000 to 10,000 acres at a cost of about $25,000.

Socony-Vacuum technicians reported that from 90 to 95 per cent of the blackfly population was exterminated at a cost of about $2.25 per acre in the 4000-acre test area in 1948. The Sovacide F-DDT fog was applied at a rate of slightly more than 1½ pt per acre from special nozzles on the exhaust stacks of the helicopter and on the ground equipment. The area received three applications at intervals of approximately 10 days during June, totaling 0.6 gal of Sovacide F and ¾ lb of DDT to each acre. Wildlife, domestic animals, humans, and vegetation were unaffected.

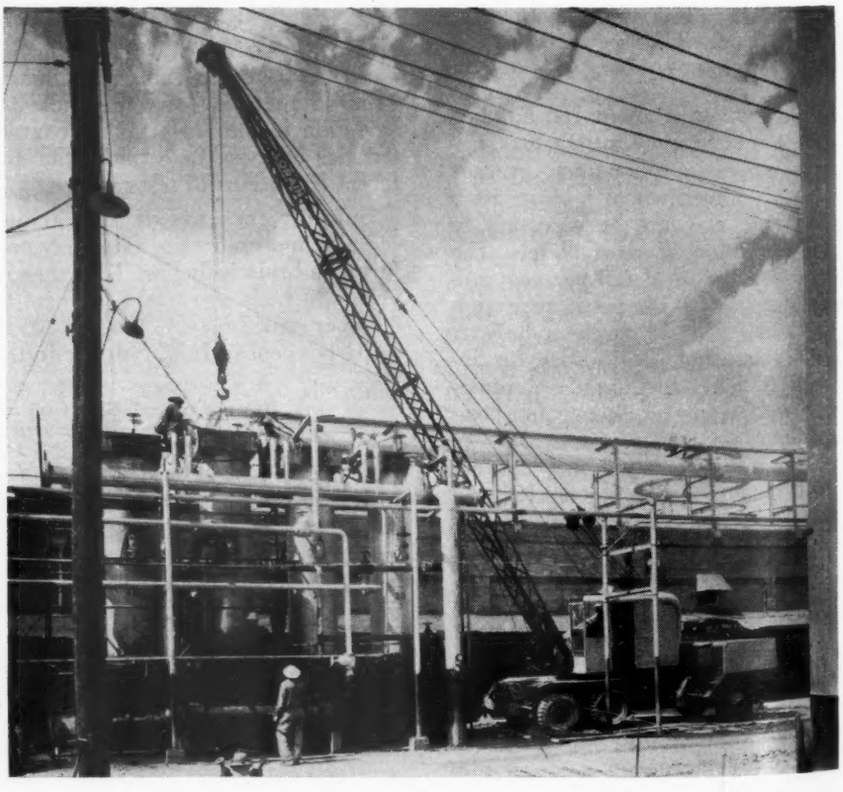
As in 1948, the cost of the 1949 blackfly-control project will be borne by the Town of Webb and resort hotels in the region and, this time, at least three TIFA units will be used together with the helicopter. Owners of the hotels in the treated area said they experienced capacity registrations during June, 1948, compared with 40 per cent of capacity in the preceeding June.

In addition, a higher percentage of hotel guests stayed for the entire periods of their reservations in 1948. Merchants reported increases in trade up to 300 per cent over June, 1947, while golf courses were used more freely than ever before.

Named Director

William Lee Davidson, an international authority on atomic energy, has been named director of The B. F. Goodrich Company's physical research department, it was announced by Howard E. Fritz, B. F. Goodrich research vice president.

Mobile Crane. *Serving the Magnolia Petroleum Company refinery on a typical close-quarter operation is this Lorain 6 by 6 Moto-Crane. The 20-ton crane can roam the refinery area at speeds of from 1 to 30 mph. It handles numerous maintenance and construction jobs.*



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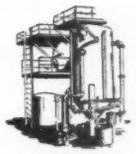

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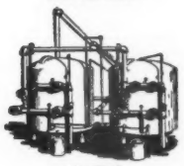

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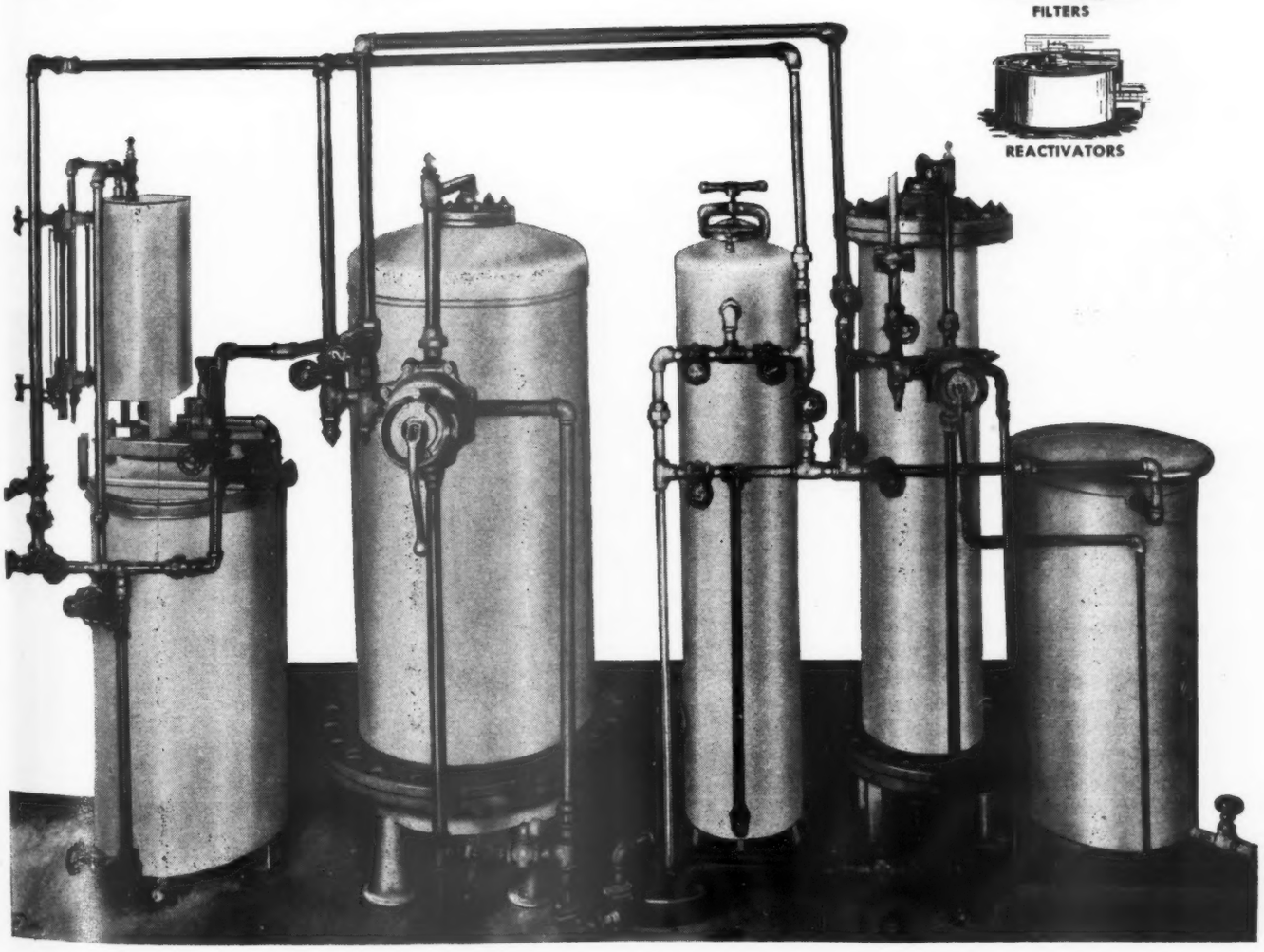


Convert War Plant to Commercial Operation

WHEN the war ended in 1945, the Government-owned, 100-octane gasoline plant of Associated Refineries, near Duncan, Oklahoma, was shut down, like most of the other war plants, and doubt existed generally that it could ever be operated profitably under peacetime conditions. Today this refinery, having been purchased from the government by Sunray Oil Corporation, is processing about 20,000 bbl of Oklahoma crude daily, after a most remarkable reconversion job.

The plant is making a variety of salable products—no 100-octane gasoline—and has earned a profit from the first day it went into operation under Sunray ownership.

When Sunray officials first surveyed the Associated Refineries' facilities they found an exceedingly well planned and well constructed plant, which, however, had been designed for maximum production of 100-octane gasoline and nothing else. Principal elements were a two-stage, fluid catalytic cracking plant with a charging capacity of 12,000 bbl of fresh feed per day; a gas concentration system, a hydrogen fluoride alkylation unit, which produced 2500 bbl per day of alkylate; an isomerization plant capable of producing 300 bbl per day of isobutane; and a modern steam plant of five boilers, each delivering 55,000 lb of steam per hour at 275 psig. The plant had produced about 250,000 bbl per month of 100-octane gasoline during wartime.

Auxiliary equipment included three large forced-draft cooling towers, necessitated by the large water requirements of the alkylation unit. A plentiful water supply was assured by a pipe line system, including pumping facilities, to Lake Duncan, about 8 miles away.

Tankage includes rundown, charging stock and product storage tanks, among which are three 80,000-bbl floating roof gasoline tanks and a number of spheres for the storage of butane, isobutane and butylenes.

Among other structures were an office building, a change house, warehouses, a well equipped machine shop, a big pumphouse, electric substations and a number of dwellings for key personnel.

There is a large, modern loading rack for tank cars and exceptionally complete facilities for loading and unloading trucks. The latter include a checkhouse, equipment for steaming out truck tanks, and a well equipped garage.

The tract on which the units are situated is large, allowing for future expansion, and is enclosed by a high wire fence. Roadways and walks are asphalt-paved. An adequate crude supply is at hand from the nearby Velma field; low-cost electricity and natural gas are available.

All these factors were on the credit side of the ledger as the Sunray management viewed the picture and considered the possibility of converting the plant into a commercial refinery.

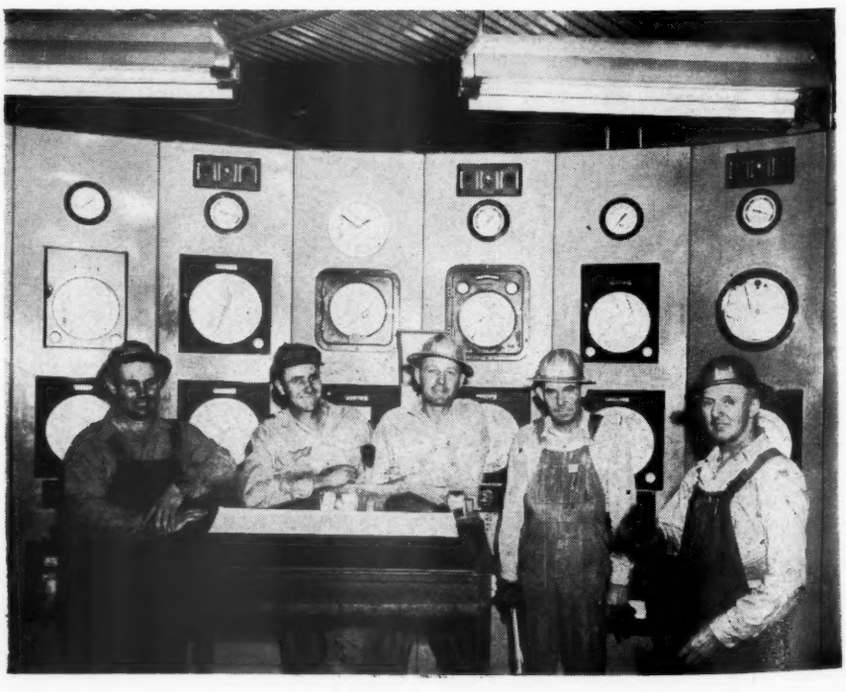
Sunray officials, led by F. L. Martin, executive vice president and head of the refining department, studied the problem of conversion in collaboration with Universal Oil Products Company engineers. Universal designed the entire original plant, placed it on steam, trained the operating personnel, and supervised the entire wartime operation. A plan was developed and agreed upon, the plant was purchased with the aid of the advice of Universal officials, in October, 1947, and the conversion was begun immediately.

The problem was to transform the refinery to profitable commercial operation as speedily and as economically as possible, making use of existing facilities to the fullest extent. The project was laid out and all elements for reconversion were designed by Universal engineers. The general contractor was Refinery Engineering Company of Tulsa, which did all the construction work except that on the cat cracker.

The refinery possessed no pipe lines to afford cheap transportation for crude in and products out, inasmuch as it had been designed to operate exclusively on gas oil, which was delivered by truck from eight nearby refineries, and to produce aviation gasoline which was shipped out by tank car.

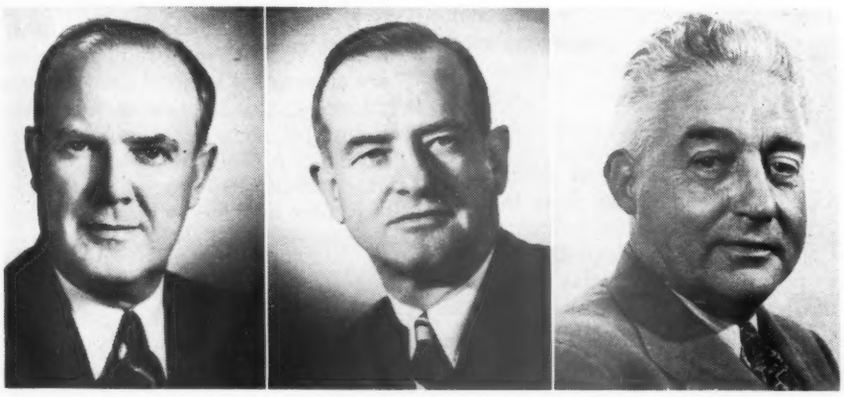
Sunray's original refinery, capacity 12,000 bbl per day is located at Allen,

The longest run to date in the Dubbs thermal cracking unit at the Sunray plant was made by the men shown here by the control board. They are, Ira Iker, left, in charge of the control board; Luther Jones, stillman in charge of the unit during his shift; W. J. McInroy, relief stillman and operator; Ed Dean, stillman, and George Watson, operator.



Oklahoma, some 100 miles northeast of Duncan by pipe line route. While the reconstruction work was in progress at the refinery, Sunray crews were busy laying an 8-in. products pipe line from Duncan to Allen for products exchange, and to storage at Allen. At the same time, a short line was being laid to bring crude from the Velma field to the refinery. Additional crude oil gathering lines are being laid to various fields in south-central Oklahoma. Three modern pipe line pump stations and eight 80,00-bbl storage tanks were constructed at Allen, Wynnewood, and Duncan. At Drumright, Sunray finished products are delivered to the Great Lakes Pipe Line system through an 83-mile 8-in. line from Allen.

There was no topping unit and no desalting equipment, a necessity for treating Velma crude, high in salt, sulphur and asphalt. A vacuum unit was needed to recover the heavy, waxy gas oil from the topped crude and a vis-breaking operation was required to make salable fuel oil from the heavy residue. There was no provision for treating crude distillation products.



Floyd L. Martin, executive vice president and head of refining operations for Sunray, who was in charge of the redesign and conversion of the unit.

C. H. Wright, president of Sunray Oil Corporation, which converted Associated Wartime aviation fuel refinery to peacetime design and operation.

R. L. Johnson, manager of the Duncan (Associated) Oklahoma, rebuilt refinery, who supervised redesign operations.

As operated in wartime, the light gases from the cat cracker were charged to the alkylation unit to produce aviation alkylate. That procedure being no longer advantageous under the proposed new operating schedule, a polymerization unit and a propane separation unit were added to prepare this product for the LPG market. It was necessary to install additional tankage on connection with this operation.

Universal engineers, in collaboration with Sunray engineers, started with the revamping of the cat cracker. This unit, as before mentioned, was built for two-stage operation, one stage for cracking fresh gas oil and the other for retreating the cracked gasoline. The two stages had a common regenerator but two reactors, two large fractionating columns and separate auxiliaries, such as condenser boxes.

It was proposed to operate the cat cracker as a single stage unit, which required extensive changes in both the reactor and regenerator sections. The large feed heater was not necessary for this operation, so this heater and the retreat fractionating column were taken as the basic elements for a new topping unit.

In order to increase the crude capacity of the converted plant it was decided to preflash the crude. A heat exchanger from the alkylation unit and the debutanizer tower from the gas concentration system were combined into a preflashing unit. About 15 per cent of light straightrun gasoline is flashed off when the charge to the crude unit is preheated to about 400°F. The improvised crude unit and the preflashing system give the plant its 20,000-bbl per day crude capacity.

A large settler from the alkylation unit was converted into a vacuum unit, with the addition of a small heater and necessary auxiliaries.

A poly unit was built to handle the gases from the crude unit and the cat cracker. A propane unit also was installed. These were constructed by the utilization of equipment on the ground, with the exception of the poly unit reactors and the propane storage tanks, which were bought new. Treating equipment for the various products was added also.

Actual construction work was begun in October, 1947; on December 5, the desalter and crude unit went into operation. In the meantime, construction of additional storage had been added so that sufficient tanks were completed to store the products which were to be further processed when the other necessary elements of the plant became ready.

Construction of the vacuum unit had been so timed as to have it ready for operation before the accumulated stocks of topped crude from the operation of the crude unit became too great. All the light products from the crude unit were immediately made salable, the necessary treating facilities having been provided in advance.

Using one of the existing towers, the straightrun gasoline was stabilized to remove propane and lighter fractions, including hydrogen sulfide. The vacuum unit flashed off gas oil as charge for the cat cracker, leaving heavy, high-viscosity asphaltic bottoms.

In order to render this rapidly accumulating material salable and dispose of it before the storage tanks were filled, the vis-breaker was put into operation to reduce the viscosity of the vacuum bottoms, and to start up the cat cracker which would produce low viscosity material for blending.

While work on the cat cracker proceeded, the gas concentration system was remodeled to separate the large quantities of propane, propylene, butanes and butylenes which the cat cracker would produce, and the poly unit was constructed. The timing was accurate; both the gas concentration system and the poly plant were ready when the cat cracker was placed on stream.

Fractionating equipment was installed to separate butane from the poly unit's effluent gases, and this butane, stored in the spheres, is used for blending with gasoline from the Allen and Duncan plants to control vapor pressure.

Equipment was installed for separating, liquefying, treating and drying propane, which is stored in new propane storage tanks.

Treating facilities for poly feed and product were ready on schedule.

Increasing its production step by step, the plan has been in full operation for nearly a year, demonstrating how a refinery designed exclusively for war production can be converted to profitable peacetime operation.

* * *

Gulf Phosphate Plant

Gulf Chemical Company has started production of phosphoric acid and various other sodium and calcium phosphates at its new $1,500,000 plant on the Houston ship channel south of Galena Park.

The company's products are used in the foods, plastics, textiles, fertilizer, soap making, and oil industries.

NEWS

Gas Company Builds Plant

Northern Utilities Gas Company has installed a gas treating plant in the Sand Draw field, Fremont county, Wyoming, for processing gas with high sulphur content from the Embar zone. Operations at the plant were begun in mid-December. Sinclair-Wyoming Oil Company recently completed its first gas well in the Embar formation. The gas is now being processed, and distillate sold from the field.

Northern Utilities purchases sweet gas from the Sundance and Frontier horizons in the field.

Award to Shell Refining

The Wilmington-Dominguez Refinery of Shell Oil Company, Inc. has been awarded the National Safety Council's "Distinguished Service to Safety Award" for 1947-1948.

In winning this national honor for the third time, the refinery has scored one of the outstanding achievements in the history of industrial safety. Together with Shell's Martinez Refinery, these plants were the first refineries in the United States ever to win the award. They were the first ever to receive the award a second time. And now they are the first in history to receive the award a third time.

Awarded Fellowship

Black, Sivalls and Bryson, Inc., Kansas City, Missouri, has established a graduate research fellowship in Chemical Engineering at the University of Oklahoma. This grant, to be known as the Black, Sivalls, and Bryson Fellowship, is to sponsor fundamental research on the purification of natural gas mixtures.

Eugene L. McCarthy, Corpus Christi, Texas, (B.A. University of Texas, B.S. Texas College of Arts and Industries) has been awarded this fellowship. His research will be directed by Professor Laurance S. Reid.

Dresser Executive Reports On European Recovery

Private enterprise has a role to play in the rehabilitation of Europe, which is quite apart from anything that can be accomplished by this or other governments, it was reported by J. B. O'Connor, executive vice president of Dresser Industries, Inc.

Back from several weeks on the Continent, during which he visited the industrial areas of Italy, France, Switzerland, Belgium, and Germany, O'Connor found the pace of economic recovery is being most accelerated where it has been possible to work out a combination of American engineering "know how" with the labor and materials available within the countries concerned.

The extent to which Italy has recovered from the ravages of war is of great significance, in O'Connor's opinion. He reports, for example, that in the Po Valley, where most manufacturing in Italy is done, tremendous possibilities are developing in the use of methane or natural gas for industrial purposes. Sufficient drilling of wells has already been done to indicate that supplies of petroleum products are more than adequate to supply the needs of a substantial amount of industry in that area, which will then be independent of coal imports.

"The Italian steel industry is beginning to make extensive use of natural gas as a fuel," O'Connor said. One open hearth furnace of the Dalmine Company, Bergamo, is already operating on natural gas and two additional furnaces are soon to follow.

Equally interesting is the possibility of developing in Italy a great chemical industry. There is a great demand, he points out, for synthetic ammonia, which is used in the manufacture of fertilizers. Synthetic gasoline, which can be manufactured from natural gas coming from fields under development in the Po Valley, would be equally valuable for industrial purposes.

Belgium, one European country to get off to a flying start following the end of the war, is today greatly in need of synthetic ammonia plants for the production of fertilizers, O'Connor discovered. Because Germany, which once used to be the source of such chemicals for the greater part of the Continent, is no longer able to meet the demand, he estimates that a score or more synthetic ammonia installations are needed.

"In another activity Belgium is making great progress in experimental work in the underground gasification of coal," he said, "and is preparing to continue this work on a large scale."

In Germany, according to O'Connor, the No. 1 problem is re-employing the brains of the country, and in so doing getting manufacturers back on their feet. It is particularly important, he believes, to find employment once more for technical talent.

In the Ruhr, O'Connor found, German synthetic gas-producing plants are all running in good shape. Most of them, he said, have orders from other industries striving to get back into production that will extend over the next three to five years.

Export business, which would help Germany to get back on a self-sustaining basis, is limited, O'Connor believes, because of the low ratio of three marks to the dollar, established by the military governments of the occupying powers. What is needed, as he sees it, is a more liberal ratio, possibly nine marks to the dollar.

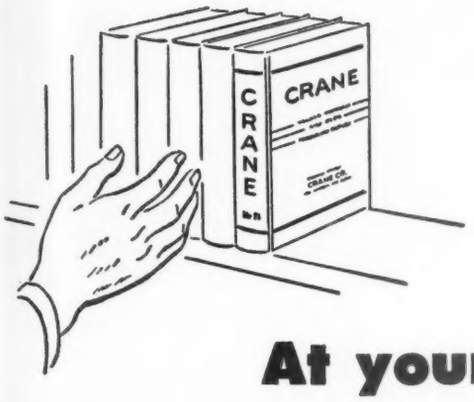
New Refinery for Canada

Charles Hay, president of Hi-Way Refineries, Ltd., has announced the letting of a contract for a new oil refinery at Saskatoon, Saskatchewan. The plant will consist of a 2000-bbl per day crude topping unit and a 500-bbl per day Dubbs licensed thermal cracking unit, together with auxiliaries to provide a complete modern refinery.

The contract for the design, engineering, and construction has been awarded to The Refinery Engineering Company of Tulsa, Oklahoma.

CONFERENCE ON CRACKING HELD IN ILLINOIS

Representatives present at the conference on cracking, which was held recently at the Sinclair Research Laboratories in Harvey, Illinois. T. D. Tifft, assistant chief engineer; assistant superintendents, W. V. Ischie of East Chicago, J. D. Siefer of Houston, C. F. Mallory of Corpus Christi, R. E. Howe of Sinclair, Wyoming, E. W. Griscom of Marcus Hook, Pennsylvania, T. B. Kimball, technical assistant to vice-president in charge of manufacturing, E. C. Herthel, manager, research and development department, Harvey, L. F. Strader, assistant superintendent, Watson Refinery, Los Angeles, California, F. B. Bluhm, head of inspection department, and O. F. Campbell, combustion engineer. All the men above are with Sinclair except L. F. Strader, who is with Richfield, a subsidiary.



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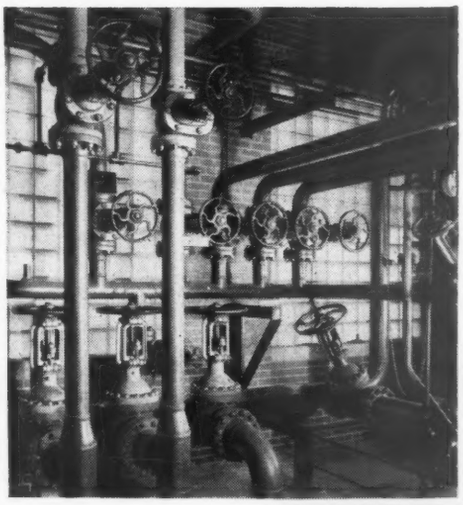
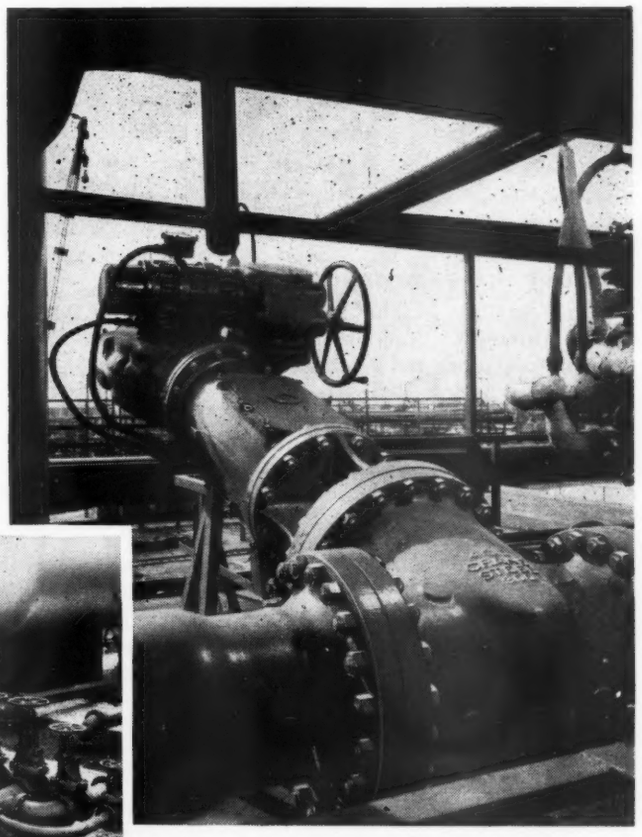


Crane 4 and 6-inch 300-pound cast steel gate valves on lines to pump-out pump in pump room of vapor recovery unit.

Lines on manifold and mixing coils in continuous sweetening plant equipped with Crane iron body gate valves and flanged fittings.



Crane 14-inch, 300-pound, motor-operated gate valve on gas line atop compressor house at catalytic cracking unit.

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NEWS

Airetool Branch Offices

During the past year, three new branch offices have been opened by the Airetool Manufacturing Company of Springfield, Ohio, manufacturers of tube cleaners, expanders, and refinery specialties, as a means of keeping pace with a growing demand for the company's products.

First of the new branch offices was opened in Philadelphia. The second is located in Baton Rouge, Louisiana, while the third and most recent was opened in Tulsa, Oklahoma.

James M. Brown, company representative who had been in charge of the Baton Rouge office since it was opened in May, 1947, was given the Tulsa assignment when that office was started late in 1948. As part of his present assignment as manager of the new Tulsa branch, Brown will be giving Airetool service to customers in Oklahoma, North and West Texas, and eastern New Mexico. He will also be available for service calls in Kansas.

Asphalt Firms Consolidated

Consolidation of the western asphalt business of Standard Oil Company of California and its subsidiaries, effective January 1, 1949, has been announced by T. S. Petersen, president of Standard. The expanded operations will be carried on by Stancal Asphalt and Bitumuls Company, formerly known as California Asphalt Corporation.

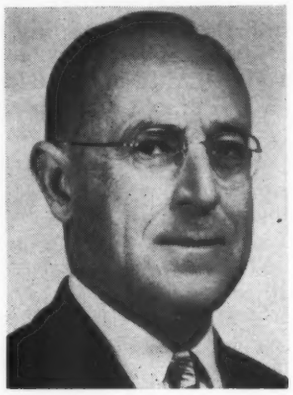
Merged into Stancal will be the western marketing staffs of American

C. W. Stewart

Bitumuls Company, another subsidiary, and Standard's own asphalt division. In addition to the California Asphalt Corporation refinery in Portland, the new company will operate the asphalt emulsion plants of American Bitumuls in Oakland and Inglewood, California, and Tucson, Arizona.

C. W. Stewart, head of American Bitumuls, will be president of the Stancal organization, and N. H. Angell, formerly manager of Standard's asphalt division, will be vice president in charge of sales.

"This move is being made in recognition of the growing importance of the asphalt business, both industrially and for paving," Petersen said. "Consolidation of the various types of asphalt products offered will enable the Stancal Asphalt and Bitumuls Company to present a complete line for the convenience of customers and to pro-



N. H. Angell

vide them with the fastest possible delivery service."

Stancal will cover the territory west of the Rocky Mountains, while American Bitumuls will continue to operate east of the Rockies as a subsidiary. The home office will be in San Francisco, with district offices in Oakland, Inglewood, Portland and Tucson.

Oakite's 40th Anniversay

February this year holds particular significance for Oakite Products, Inc., pioneers in the field of industrial cleaning materials and methods, for it marks the completion of Oakite's fortieth year of cooperation with industry on its production and maintenance cleaning procedures. Since its founding in 1909, the company has steadfastly stressed service over and beyond the mere sale of its products. In support of this policy, it maintains a nationwide field service organization of 180 experienced technical representatives to provide in-plant assistance and to assure the most effective and economical application of its materials by its customers. Striking testimony to the effectiveness of this basic principle is indicated by the fact that, today, the company supplies more than 80 specialized compounds for cleaning and related operations in the petroleum producing, refining, and distributing field and in many other branches of industry.

H. W. Arduser *R. H. Duenner, Jr.*

Tube-Turn Distributor

Ardun Company of Tulsa, Oklahoma has been appointed a distributor of Tube-Turn welding fittings and flanges, it is announced by John G. Seiler, executive vice president of Tube Turns, Inc. The firm, which has its modern offices and warehouse at 317 South Detroit Avenue, is a partnership formed by two Tulsans, H. W. (Doc) Arduser and Robert H. Duenner, Jr.

Chemists to Meet

The American Chemical Society will hold its national meeting in San Francisco from March 28 to April 1. The Fairmont Hotel will be general headquarters for the meeting, while the Petroleum Division will have its headquarters at the Mark Hopkins.

The analytical chemists will cooperate with the Petroleum Division in a symposium on the use of microchemistry in the petroleum industry, with Harry Levin of The Texas Company, Beacon, New York, presiding. Also scheduled by the division is a meeting on "Organic Sulphur Compounds as Related to Petroleum," of which Dr. A. A. O'Kelly of the Socony-Vacuum Oil Company, Paulsboro, New Jersey, will be chairman.

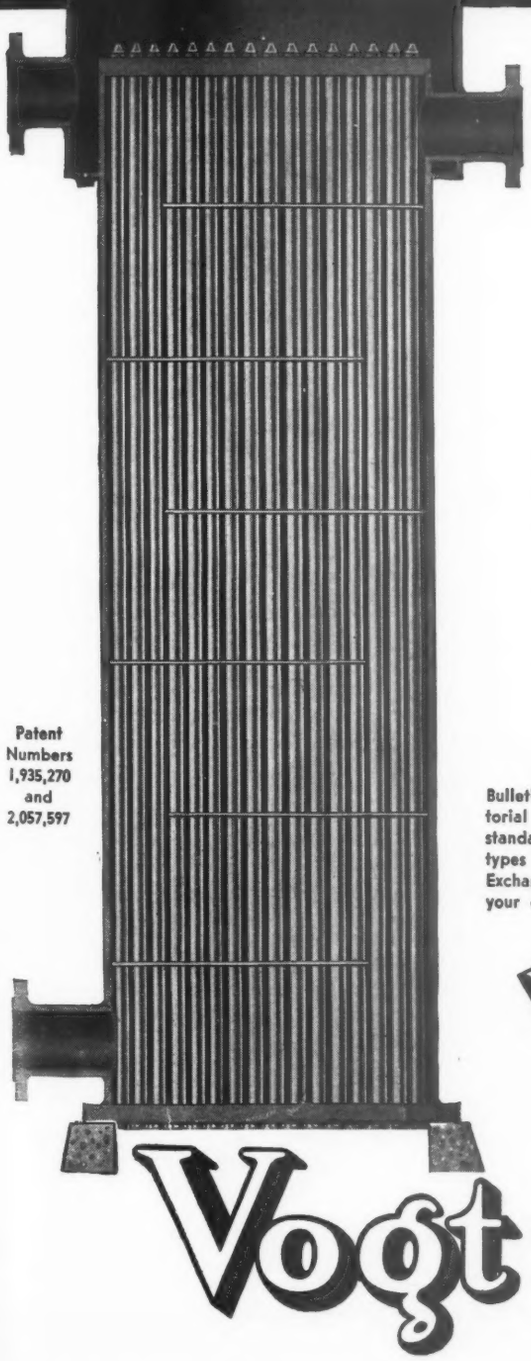
The Petroleum Division will sponsor a high polymer forum, seventh in a series devoted to progress in the study of the giant molecular structures making up rubbers, fibers, and plastics. Dr. William J. Sparks, director of the chemical division of the Standard Oil Development Company, Elizabeth, New Jersey, is chairman of the committee arranging the forum, in which the Cellulose, Colloid, Paint, Varnish, and Plastics; Physical and Inorganic, and Rubber Divisions will participate.

Moves Offices

Vapor Recovery Systems Company, manufacturers of tank equipment, gas control and safety devices, has relocated its Cleveland offices at 719 Gulf Building, Pittsburgh 19, Pennsylvania. J. R. Edwards, Jr., will be in charge of this more strategically located branch office.

FILM TYPE EXCHANGERS

DETAIL SHOWING DISTRIBUTING FERRULE IN TUBE (Patent Pending)



Patent Numbers 1,935,270 and 2,057,597

Vogt engineers have taken a familiar refrigeration plant "old timer" and developed it into this modern, efficient heat exchanger.

The film type exchanger operates in a vertical position. Water introduced in the top chamber is distributed in a thin film against the inner tube walls by means of special ferrules. The shell side of the exchanger has baffles arranged to provide optimum velocities, pressure drops, and heat transfer rates. Shutdowns are eliminated because tubes can be cleaned while the unit is in operation; thus permitting the use of dirty, mud and silt depositing water.

Vogt Film Type Exchangers now serve as Jacket Water Coolers, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to condense any vapor. They are also applicable for handling liquids other than water in film flow.

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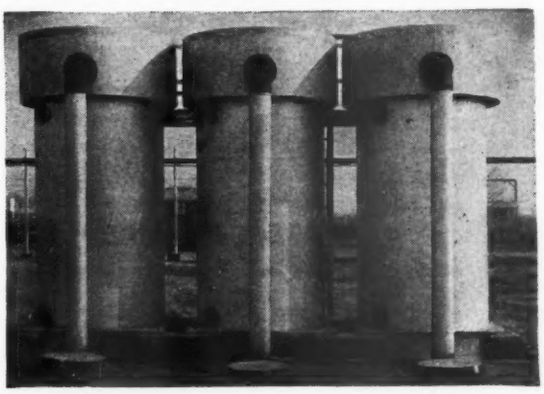
Bulletin HE-5 is a pictorial presentation of standard and special types of Vogt Heat Exchangers. Write for your copy.



Jacket Water Coolers serving engines of 7,300 H.P. Muddy well water used as cooling medium.

Vogt

HEAT TRANSFER EQUIPMENT

General Steel Products Company Opens in Dallas

General Steel Products Company opened its doors to the LP-gas industry, February 1, in Dallas, Texas. This new company is owned and operated by Bruce A. Tankel and Albert D. White, both of whom are nationally known to dealers and manufacturers in the LP-gas industry.

The plant is completely equipped with machinery to fabricate all types of pressure vessels, such as butane-propane tanks, refinery vessels, anhydrous ammonia tanks, truck and trailer transport tanks. A large, modern plant building houses machinery, offices, and steel supply at 919 West Commerce Street, Dallas. All vessels are manufactured in accordance with the ASME Codes of Construction and receive National Board inspection.

Daily Refining Capacity

A special National Petroleum Council committee headed by Robert E. Wilson, Standard Oil Company (Indiana) board chairman, has estimated a 407,800 bbl increase in refining capacity between September 20, 1948, and December 31, 1949.

The NPC committee reported refining capacity on September 20 was 6,161,600 bbl daily and estimated capacity three months later at 6,346,900 bbl daily.

For 1949 it estimated capacities at the end of each quarter, in bbl daily, as follows: first, 6,410,500; second, 6,467,800; third, 6,534,700; and fourth, 6,569,400, or an increase in 1949 of 3.5 per cent.

G. T. Tennison

M. R. Church

J. T. Jordan

Shell Decentralizes Gas-Gasoline Activities

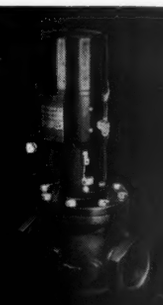
The rearrangement of Shell Oil Company's natural gas and gasoline activities has been announced by E. D. Cumming, regional vice president, Houston, Texas.

On January 1, 1949, the regional gas department was organized with George T. Tennison as regional gas manager to coordinate the gas activities of Shell's four areas east of the Rocky Mountains. He will be assisted by Ed S. Quinn, regional gas representative, coordinating gas contracts and measurements, and by John B. Haefer, Jr., regional gas representative, handling purchases and sales of volatiles.

Gasoline and cycling plant design and construction are centered in the engineering division of the regional production department. The gas engineering section, headed by Merle R. Church, regional gas engineer, will deal with the construction of plants, while the technological section, headed by John T. Jordan, regional technologist, will deal with plant design.

General Controls

G-3 SERIES HYDRAMOTOR VALVES



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POSITIVE RETURN TO NORMAL POSITION ON CURRENT FAILURE.

SIMPLIFIED TWO-WIRE CONTROL CIRCUIT. Available in normally closed or open models—single seated or semi-balanced. ½" to 12" I.P.S. —Models from 27 to 3000 P.S.I.

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Cut Tower-Cleaning Costs the Easier OAKITE Way!

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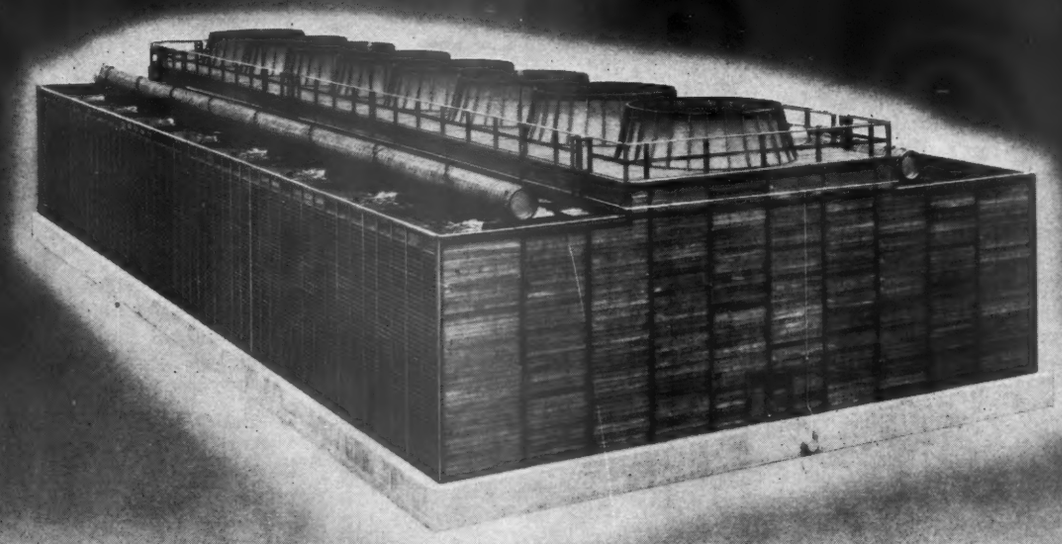

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And why is that important?

Because the Marley Open Distribution System is . . .

EASY TO INSPECT . . . it's on top of the tower, in broad daylight, never hidden from view.

EASY TO REGULATE . . . a widely varying GPM may be circulated over the tower without revamping the distribution system.

EASY TO CLEAN . . . cleaning is done with an ordinary broom . . . it is not necessary to shut down the tower or take it apart in any way.

UNUSUALLY SAFE . . . no climbing through small portholes, across slippery members . . . no danger of falling through the filling while crawling about in narrow spaces in semi-darkness while inspecting or cleaning.

VERY ECONOMICAL . . . because it's easy to clean . . . and clean distribution systems insure top performance and low operating costs. Also, the diffusion decking underneath gives excellent water break-up with no added pumping head.

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PLANT AIDS

Fire Extinguisher Mounting

It has been discovered that certain types of fire equipment have shown a marked decrease in efficiency when mounted directly upon the base, but will maintain their effectiveness for an indefinite period of time if mounted, or stored, in a different position. Whether mounted inside a building or on posts outside, the type of mounting is substantially the same. So that the chemicals inside the container, and the hose outside the unit will always be in condition for instant use, the extinguisher is mounted in an "up-side down" position. A shallow cup is welded to a bracket which in turn is attached to a post or studding so the hand-wheel of the unit will fit into it snugly. At the top, or for the original "base" of the unit is a hinged combined cover and retainer to hold the unit in the stored position without being easily knocked from the brackets, but so it can be removed readily by lifting the hinged cover. If sedimentation occurs in the case, it will be opposite the hose outlet, and

the hose itself hangs straight down without distortion and damage from continued bending.

Steam Engine Cut Off and Pressure

An interesting table compiled from a chart comparing the mean effective pressures of uniflow engines of various initial pressures with those of corliss engines of the same initial pressures shows that the corliss engine has the advantage so far as pressure is concerned where both types are condensing. But where both types are non-condensing the uniflow shows higher pressures at 40 per cent cut-off.

The engineer in any plant where both corliss and uniflow engines are commonly used, will find these facts of interest and value because it is the mean effective pressure that really determines the size of engine to buy for any given purpose. Every engineer knows that the horse-power of a steam engine is directly proportional to the mean effective pressure, all other factors being equal such as length of stroke, diameter of cylinder, and speed.

The reason why there is a difference in pressures in these two types of engines lies in the fact that there is a difference in compression. Compression begins later in the corliss than in the uniflow. The greater the compression, of course, the greater the back pressure, and since back pressure must always be deducted from active pressure the corliss engine benefits in most cases. This is a point worth remembering. —W.F.S.

Mean effective pressure.

Type	Pressure, lb per sq in. ga.	Condensing or non-condensing	Cut-off, 10 per cent	Cut-off, 25 per cent	Cut-off, 40 per cent
Uniflow	125	Non-condensing	36	68	91
Corliss	125	Non-condensing	38	69	89
Uniflow	125	Condensing	45	76	98
Corliss	125	Condensing	50	85	109
Uniflow	150	Non-condensing	42	81	106
Corliss	150	Non-condensing	53	83	104
Uniflow	150	Condensing	54	92	117
Corliss	150	Condensing	65	100	124

A Better Rule for Figuring Worm Gears

Here is a new rule—and a good one—for determining the efficiency of worm gears. It is more accurate than other rules that the writer has seen in print. It relates to single worm reductions, and is as follows: Multiply the reduction ratio by 0.0047 and subtract the product from one. Thus for example if the reduction ratio is 50 to 1 we have this: $50 \times 0.0047 = 0.235$. Then $1 - 0.235 = 0.765 = 76.5$ per cent efficiency.

This rule relates only to "single reductions" and it might be well to add that it should not be applied if the reduction ratio is greater than 100 to 1, since at some point the rule would show an efficiency of zero. For instance, to work out a reduction of 213 to 1 you will find that the rule gives an efficiency of exactly zero because $0.0047 \times 213 = 1$. Subtracting 1 from 1 gives zero.

As a matter of fact single reductions as great even as 100 to 1 are seldom made because of their inefficiency. Higher efficiencies are attained by using two reductions. Two reductions, usually, are enough. For example, the total reduction is to be 50 to 1, the first reduction to be 5 to 1 and the second reduction 10 to 1. Applying the above rule for each reduction we have:

First reduction:

$-1-.0047 \times 5 = 0.977$ Efficiency

Second reduction:

$-1-.0047 \times 10 = 0.953$ Efficiency

To find the overall efficiency, multiply these two efficiencies together and get $0.977 \times 0.953 = 0.93$. This means that the efficiency will be 93 per cent as compared with the 76.5 per cent efficiency computed above using only a single reduction.

Again, assume a desired reduction of 2500 to 1. The result can be obtained in several ways, but first try a double reduction of 50 to 1 and 50 to 1. That will give us 2500 to one: In the first problem above we found the efficiency of a 50 to 1 reduction, single wheel, to be 76.5 per cent. Double reduction we would then have $0.765 \times 0.765 = 58.5$ per cent efficiency. In other words, nearly one-half of the energy would be lost in friction.

From an efficiency standpoint it would be better to make it a quadruple reduction. Thus, above it was shown that by using a 5 to 1 and a 10 to 1 double reduction the efficiency would be 93 per cent. So, using two such reductions in series the overall efficiency of the quadruple reduction would be $0.93 \times 0.93 = 0.86$ or 86 per cent efficiency as compared with 58.5 per cent. The power saving would be considerable more than 27 per cent.—W.F.S.

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Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", inclusive. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge. Also available in All Iron for process lines.

Fig. 3061—Class 300-pound Cast Steel Swing Check Valve with bolted cap and flanged ends. Disc has ample lift to permit full, straightway, unobstructed flow through the valve body.

Fig. 3003—Class 300-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem, tapered solid wedge.

Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem, tapered solid wedge.

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PERSONALS

L. W. Moore

L. W. MOORE has been elected to the presidencies of Mexican Petroleum Corporation of Georgia and of Pan-American Refining Corporation, says D. J. Smith, widely known president of the parent Pan-American Petroleum and Transport Company. Moore took over the portfolios as of January 1, 1949. The term "meteoric" has been applied to many rapid movements, properly or improperly, but it fits the business-professional career of L. W. Moore better than any other word.

Fifteen years ago Moore was merely another graduate from Massachusetts Institute of Technology. He started to work in the middle of the Depression's lowest level, in the research department of Standard of Indiana at Whiting, Indiana, the laboratory that has started so many technical and technical-executive leaders of the petroleum refining industry on their way to the top. In a short two years Pan-American P. and T. wanted him and he was transferred to New York, to be appointed manager of research for Pan-American 10 years later, still with headquarters in New York.

Pan-American Refining was expanding its manufacturing facilities somewhat rapidly, revamping, rebuilding, boosting capacities, and two years after taking the managership Moore was made a director of the refining company, also manager of manufacturing. With these advances also came directorships in Mexican Petroleum Corporation of Georgia, Pan-American Production Company, Pan-American Pipe Line and Pan-American Gas Companies, just in case he found his other duties small and inconsequential, and time hanging heavily on his hands. He remains as a director of these companies, as he takes over top-floor direction of the refining company's operations.

During Moore's sojourn in Whiting he married Arlene Scott of Cleveland, Ohio, a M.I.T.-Wellesley College romance. With three daughters the Moores live now in Mamaroneck, Westchester County, New York, home of thousands of New Haven Railroad commuters.

Moore's grand hobby of bridge playing has suffered severely from inroads on his time and energies, made by the playwork job of rebuilding an old house, purchased in the pleasant Long Island Sound "country." Rumor hath it that, large as this task looms in the total, it is progressing with the same degree of concentration that has been applied to all other jobs this man has tackled.

Moore's first and most lasting impression of Whiting and his work there is that of extreme cold, raw weather, and the attendant discomfort of being forced out into this weather frequently and without choice. One of his first jobs included driving himself willy-nilly out to the refinery separator boxes, on the edge of rampant Lake Michigan, to take samples therefrom, in the midst of the vicious winters for which this area is (in) famous. Any person who has stood on the open shore of that lake in January will recall a vivid impression of what this job was like. Quite possibly Moore studied economics and other matters all the more, an activity that induced Dr. C. C. Monrad to aid and abet his work, resulting in a need for Moore in the New York office of Pan-American.

☆ ☆ ☆

Roland Vokac is now associated with the Husky Refining Company of Cody, Wyoming, in a consulting and advisory capacity. He will assist in the development of Husky's industrial asphalts as well as advise in all their manufacturing operations. For a number of years Vokac has been connected with the Berry Asphalt Company in Chicago in a research capacity. He has had extensive experience in both direct manufacturing and application of asphalt in highway use as well as industrial uses.

I. M. Hemphill, manager of Shell's Martinez refinery retired December 31, closing a 34-year record of service with Shell. Hemphill started with the company at Martinez in 1915 and was manager of the distillation department for 13 years before becoming superintendent of Shell's New Orleans refinery for a year. From 1929 to 1942 he was at the company's Wilmington refinery in Southern California where he was apointed manager in 1935. He returned to Martinez as refinery manager in 1942.

J. A. Tench, who has been superintendent at Martinez for the past two years, succeeded Hemphill. **R. C. Barton** was transferred from Shell's Wilmington refinery to fill the vacancy created by Tench's promotion.

☆ ☆ ☆

Joseph A. Neubauer has been appointed technical director for the Columbia Chemical Division of Pittsburgh Plate Glass Company and for Southern Alkali Corporation. He has served as technical advisor to the Columbia Chemical Division since 1945. Neubauer was the first superintendent of the Columbia's large chlorine and caustic soda producing plant at Natrium, West Virginia, which went into production during 1943.

☆ ☆ ☆

Irving A. Cole, appointed manager of technical division by Attapulgus Clay Company, has assumed his new duties in the company's laboratories at Camden, New Jersey. Cole previously was engaged in the sales department. He holds a Bachelor's degree in chemical engineering from Cornell University where he graduated in 1943. Prior to joining Attapulgus in 1946, Cole was associated with the research and development department of Atlantic Refining Company.

Irving A. Cole

James Forrestal has been appointed general manager of the Ozalid Division of General Aniline and Film Corporation, Cary R. Wagner, vice president in charge of operations has announced. Acting general manager of the division since last May, Forrestal was formerly general sales manager of the Ansco film and camera division of General Aniline.

☆ ☆ ☆

J. M. "Jim" McNeill, Union Oil Company of California, has been appointed assistant to the vice president, reporting to Ronald D. Gibbs. McNeill will be responsible for all contracts covering the sale, purchase, exchange, and processing of natural gas. A graduate of the University of Southern California with degree in petroleum engineering, he was employed as a

J. M. McNeill

roustabout by Union Oil Company in 1933, and later became field engineer. In March 1941, he was made production foreman at Santa Fe Springs, and after service in the U. S. Navy during the war, he returned and became division engineer at Santa Fe Springs, district foreman at Richfield-Brea district, and finally, prior to his present promotion, special field engineer, working out of the Los Angeles office.

☆ ☆ ☆

J. R. Bailey, formerly superintendent of development of Continental Oil Company's natural gasoline and gas division, has been promoted to assistant manager of the division. He joined Continental in 1940 as district engineer in the natural gasoline and gas division at Basile, Louisiana. Promotions brought him to Ponca City as division engineer in 1942 and he was promoted to superintendent of development in 1947.

F. B. Willson, formerly assistant to the manager, succeeded Bailey. Willson joined Continental in 1936 at Lance Creek, Wyoming, and successively was promoted, becoming assistant process engineer at Ponca City in 1943. He was named assistant to the manager of the division in 1946.

E. D. Gray Honored. More than 250 persons, including company executives, management officials, foremen, and supervisors of Standard Oil Company of California honored E. D. Gray, assistant to the general manager of the Richmond refinery on December 29, 1948, at a luncheon. Two days later Gray retired after completing 50 years' service with Standard Oil. Gray, third from left, is congratulated here by the manufacturing department personnel director, A. C. Moorehead. Looking on, left to right, are R. K. Rowell, refinery general manager, O. N. Miller, manager, manufacturing department, G. A. Davidson, vice president, Standard of California, and F. H. Smith, general manager, operations.

J. M. Cook, formerly production clerk, became chief clerk of the natural gasoline and gas division.

J. H. Olehy, formerly director of technical services in Continental's manufacturing department, has been appointed manager of the enlarged general engineering department.

M. E. Clawson, chief engineer for the past 13 years, will continue as chief construction engineer, and **T. O. Duller,** formerly assistant chief engineer, has been appointed chief design engineer.

Announcement of the appointments was made by President L. F. McCollum, who stated that the engineering department will continue to report to the management through **Harold G. Osborn,** vice president.

☆ ☆ ☆

H. R. Boehmer, general superintendent of the Sugar Creek, Missouri, refinery of Standard Oil Company (Indiana), has been promoted to manager at Sugar Creek to succeed the late R. E. Beard. Boehmer joined Standard in 1915 at the Whiting, Indiana, refinery and was transferred to Sugar Creek as a chemist in 1916. He became superintendent of the Sugar Creek refinery in 1920 and general superintendent in 1946.

R. M. Cash, superintendent of the process division at Sugar Creek, has succeeded Boehmer as the general superintendent. Cash became associated with the company in 1926 as a laboratory assistant at Sugar Creek. After advancing to foreman of the asphalt department in 1932 and general foreman in 1945, he was appointed superintendent of the process division in 1946.

R. E. Beard, who died December 22, 1948 at the age of 57, joined Standard Oil Company (Indiana) in 1920 as a chemist in the Whiting research laboratory. In 1922 he was transferred to the Casper, Wyoming, laboratory and then was transferred from laboratory to operating work the next year. After advancing through various operating positions to manager of the Rocky Mountain division, he became manager of the Sugar Creek refinery in 1939.

Lynn R. Strawn

Lynn R. Strawn, formerly of The Texas Company at Port Arthur, has been appointed manager of the Neches Plant of Jefferson Chemical Company, Inc. Prior to accepting the new position with Jefferson, he was in charge of process engineering activities in all phases of light oil and lubricating oil manufacture and gas processing at the Port Arthur plant. He replaces **A. A. Triska,** who has been transferred to New York where he will assume new duties with Jefferson as assistant to the production department manager.

Thomas C. Reeves, formerly chief engineer of the Sherman-Williams Company plant at Bound Brook, New Jersey, has joined the Eastern sales division staff of Oliver United Filters, Inc.

☆ ☆ ☆

David P. Graham, vice president of Peabody Engineering Corporation, New York City, died on December 18 at his home in Westbury, Long Island. Graham graduated from Stevens Institute of Technology in the class of '23. After graduation, he went to South America as a test engineer for three years and returned to join Peabody Engineering Corporation as sales engineer. During his 22 years with Peabody he rose from sales engineer to sales manager, manager of gas scrubber division, assistant to the president, and was later appointed executive vice president.

☆ ☆ ☆

E. Duer Reeves has been elected executive vice president of Standard Oil Development Company, according to an announcement from E. V. Murphree, company president. Reeves, who has been a vice president and a director since 1947, was in charge of a research department that conducted the first experiments leading to development of the modern fluid catalyst cracking plant, Murphree said. **Edwin J. Gohr** was named as vice president and director of Standard Development. Since 1945 Gohr has been assistant manager of the research and development department. He aided in designing the first fluid catalytic cracking unit, which began operation at Baton Rouge in May 1942.

☆ ☆ ☆

Harry Brubaker has been appointed assistant manager of the Sid Richardson Carbon Company's division office at Akron, Ohio. Brubaker has had experience with The B. F. Goodrich Company, Hycar Chemical Company, and Phillips Petroleum Company in its Rubber Chemicals Division at Akron.

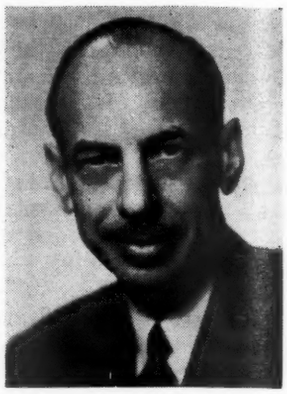
☆ ☆ ☆

R. B. Malone, superintendent of the Pratt Works of the Socony-Vacuum Oil Company, Inc., in Long Island City, New York, retired January 1 after 45 years of service. He started as a clerk in the Pratt Works and was transferred four years later to the Pratt-Long Island refinery, becoming chief clerk in 1912. After two years he became foreman of the grease and compounding department, then assistant superintendent. He was named Pratt Works superintendent in 1927.

W. L. Linton, superintendent of the Sone and Fleming refinery, will become manager of all of the company's East River refinery operations. **E. F. Pinney** will be superintendent of the Pratt Works and assistant to Linton. **F. W. Hadley** is superintendent of the Sone and Fleming refinery and **E. J. Tully** is superintendent of the grease and compounding department.

☆ ☆ ☆

J. T. Deane has been elected a vice president of Oronite Chemical Company, G. L. Parkhurst, Oronite president, announces. Deane comes to Oronite from California Oil Company's Oak Point, Louisiana, plant. He was a vice president of that company, and manager in charge of manufacturing of lubricating oil additives.



A. C. Atwater

A. C. Atwater has joined the Houston staff of Thomas Bryan and Associates as manager of the petroleum and chemical division. A graduate of MIT with BS and MS degrees in chemical engineering, Atwater has had a colorful background in his associations with many of the world's largest companies. He was development engineer on cracking with Atlantic Refining Company, and later assistant superintendent of its Pittsburgh refinery.

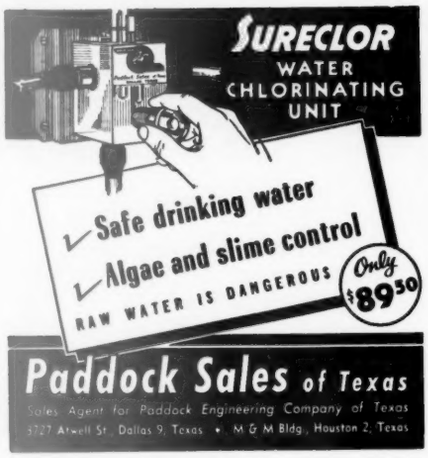
In 1928, Atwater went with Arthur G. McKee and Company, of Cleveland, as process design engineer on complete refinery construction. Service with this company took him to Japan, France, Italy, Germany, Rumania, and most recently Holland, where he was project and purchasing manager for the construction of the Rotterdam refinery of Caltex.

☆ ☆ ☆

E. J. Yocom, superintendent at Stanolind Oil and Gas Company's South Jennings recycling plant, Jennings, Louisiana, has been transferred to the Hastings gasoline plant, Alvin, Texas. He succeeds **C. W. Ward,** who has been made superintendent of Stanolind's new Elk Basin plant, Powell, Wyoming. Yocom has been with Stanolind since 1933. He served as plant chemist and plant foreman at the South Jennings plant before being made superintendent there.

H. W. Jones, plant foreman at Superior refinery, Vivian, Louisiana, was made superintendent at the South Jennings plant, succeeding Yocom. Jones joined the company in 1933, and has been at the Superior refinery since then.

V. E. O'Donnell, plant foreman at La Rosa recycling plant, Woodsboro, Texas, has been promoted to superintendent of the Luby gasoline plant, Bishop, Texas. He succeeds **H. J. Olinger,** who was killed in a recent automobile accident. O'Donnell was plant engineer at the South Jennings plant for nearly three years before going to La Rosa as plant foreman in 1947.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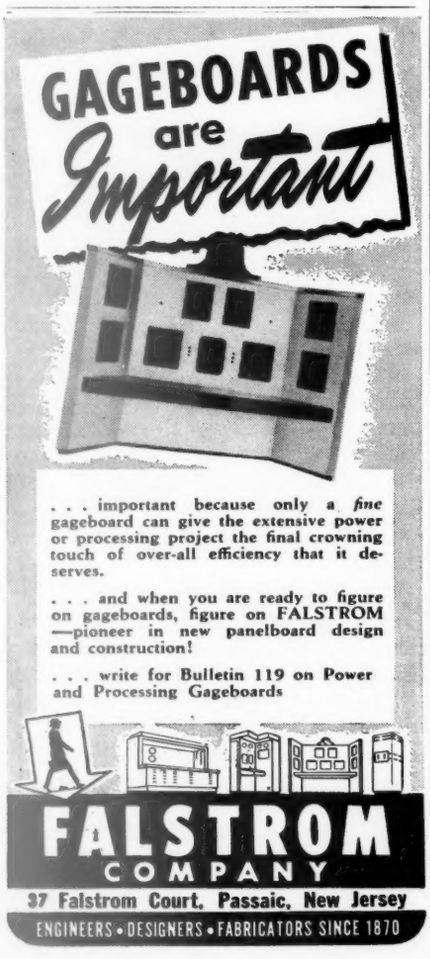
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RUNS TO STILLS AND PRODUCTION AT REFINERIES IN THE UNITED STATES, 1932-1947

(Thousands of barrels unless otherwise indicated)

	1932	1933	1934	1935	1936	1937	1938	1939
Input: Crude petroleum								
Domestic	777,696	825,786	860,776	933,659	1,034,637	1,157,444	1,138,828	1,204,350
Foreign	42,301	35,468	34,860	32,131	33,933	25,996	26,187	33,490
Total	819,997	861,254	895,636	965,790	1,068,570	1,183,440	1,165,015	1,237,840
Unfinished reruns (net)								
Gasoline	+ 1,861	— 4,547	+ 3,007	— 1,032	— 486	+ 128	+ 1,616	+ 439
Other			— 1,949	+ 2,412	+ 8,962	+ 7,931	+ 4,530	+11,731
Natural gasoline	26,332	25,346	28,162	31,025	33,817	39,381	39,961	39,606
Total input	848,190	882,053	924,856	998,195	1,110,863	1,230,880	1,211,122	1,289,616
Output:								
Gasoline	392,623	401,591	416,932	457,842	504,811	559,141	556,012	596,501
Kerosine	43,836	48,977	53,855	55,813	56,082	65,308	64,580	68,521
Distillate fuel oil	69,467	78,920	94,972	100,235	125,906	146,706	151,774	161,746
Residual fuel oil	225,283	237,519	240,381	259,826	287,968	312,064	294,890	305,944
Lubricating oil	22,433	23,775	26,373	27,853	30,927	35,321	30,826	35,036
Wax	1,639	1,677	1,674	1,608	1,689	1,863	1,555	1,659
Coke	9,123	7,900	6,500	7,290	6,891	6,533	8,011	8,332
Asphalt	13,612	12,757	15,623	17,133	21,278	23,001	23,878	27,248
Still gas	40,905	45,212	44,391	51,184	57,046	64,218	65,890	68,779
Road oil	6,879	5,534	6,210	6,030	7,398	8,087	7,543	7,868
Miscellaneous	1,738	1,435	1 872	1,888	2,148	2,382	1,921	2,359
Shortage	20,652	16,756	16,073	11,493	8,719	6,256	4,242	5,623
Total output	848,190	882,053	924,856	998,195	1,110,863	1,230,880	1,211,122	1,289,616
Wax (thousands of pounds)	458,920	469,560	468,720	450,240	472,920	521,640	435,400	464,520
Coke (short tons)	1,788,800	1,580,000	1,300,000	1,458,000	1,378,200	1,306,600	1,602,200	1,666,400
Asphalt (short tons)	2,474,900	2,319,500	2,840,500	3,115,100	3,868,800	4,182,000	4,341,400	4,954,200
Still gas (millions of cu ft)	160,812	170,853	169,479	197,220	226,466	241,981	250,382	261,360

	1940	1941	1942	1943	1944	1945	1946	1947
Input: Crude petroleum								
Domestic	1,252,364	1,358,246	1,319,507	1,417,559	1,622,514	1,645,862	1,645,845	1,754,987
Foreign	41,796	50,946	14,596	12,179	43,170	73,672	84,352	97,259
Total	1,294,160	1,409,192	1,334,103	1,429,738	1,665,684	1,719,534	1,730,197	1,852,246
Unfinished reruns (net)								
Gasoline	— 902	— 1,219	— 1,669	— 1,009	— 2,698	+ 4,892	+ 108	— 984
Other	+ 3,851	+ 3,204	+ 3,353	— 2,597	— 2,584	+ 5,727	+ 1,615	+ 1,227
Natural gasoline	39,547	47,825	56,595	61,198	66,902	70,324	62,861	70,692
Total input	1,336,656	1,459,002	1,392,382	1,487,330	1,727,304	1,800,477	1,794,781	1,923,181
Output:								
Gasoline	597,375	671,110	586,971	592,425	721,618	774,460	748,411	814,841
Kerosine	73,882	72,586	67,474	72,270	78,344	81,024	104,385	110,412
Distillate fuel oil	183,304	189,177	196,714	211,516	239,152	249,224	287,896	312,173
Residual fuel oil	316,221	342,367	358,901	417,306	461,455	469,492	431,364	447,795
Lubricating oil	36,765	39,539	38,626	38,679	41,106	41,867	45,645	51,765
Wax	1,833	2,393	2,502	2,697	2,883	2,921	3,003	3,624
Coke	7,633	8,244	6,692	6,942	9,017	10,117	10,621	12,077
Asphalt	29,407	36,067	34,631	37,162	38,479	39,196	44,911	49,286
Still gas	75,950	83,354	78,924	86,755	102,239	103,458	88,136	85,564
Road oil	7,771	9,149	8,039	2,295	1,556	2,686	6,175	7,074
Miscellaneous	3,202	6,266	8,117	9,660	18,278	19,080	22,539	24,348
Shortage	3,313	— 1,250	4,791	9,623	13.177	6,952	1,695	4,222
Total output	1,336,656	1,459,002	1,392,382	1,487,330	1,727,304	1,800,477	1,794,781	1,923,181
Wax (thousands of pounds)	513,240	670,040	700,560	755,160	807,240	817,880	840,840	1,014,720
Coke (short tons)	1,526,600	1,648,800	1,338,400	1,388,400	1,803,400	2,023.300	2,124,200	2,415,400
Asphalt (short tons)	5,346,700	6,557,600	6,296,500	6,756,700	6,996,100	7,126,600	8,165,600	8,961,090
Still gas (millions of cu ft)	273,420	300,074	284,126	312,318	368,061	372,449	317,290	308,030

Note: Negative quantities of reruns represent excess produced.

Conversion factors: Wax—280 pounds per barrel.
Coke—5 barrels per short ton, after 1932.
Asphalt—5.5 barrels per short ton.
Still gas—3.6 M cubic feet per barrel, after 1939.

Source: U. S. Bureau of Mines.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

SUMMARY OF PERCENTAGE YIELDS OF REFINED PRODUCTS IN THE UNITED STATES

(Computed on total crude runs to stills)

Product	1939	1940	1941	1942	1943	1944	1945	1946	1947
Finished products:									
Gasoline:									
Cracked	23.9	22.7	24.4	22.3	22.0	23.2	23.3	22.6	‡
Straight run	21.1	20.4	19.8	17.5	15.1	16.2	17.6	17.1	‡
Total gasoline	45.0	43.1	44.2	39.8	37.1	39.4	40.9	39.7	40.1
Kerosine	5.5	5.7	5.2	5.1	5.0	4.7	4.7	6.0	6.0
Distillate fuel oil	13.1	14.2	13.4	14.7	14.8	14.4	14.5	16.6	16.8
Residual fuel oil	24.7	24.4	24.3	26.9	29.2	27.7	27.3	24.9	24.2
Lubricating oil	2.8	2.8	2.8	2.9	2.7	2.5	2.4	2.6	2.8
Wax	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Coke	0.7	0.6	0.6	0.5	0.5	0.5	0.6	0.6	0.7
Asphalt	2.2	2.3	2.6	2.6	2.6	2.3	2.3	2.6	2.7
Road oil	0.6	0.6	0.6	0.6	0.2	0.1	0.2	0.4	0.4
Still gas	5.5	5.5	5.9	5.9	6.1	6.1	6.0	5.1	4.6
Miscellaneous	0.2	0.3	0.4	0.6	0.7	1.1	1.1	1.3	1.3
Unfinished products:									
Gasoline	⊙	0.1	0.1	0.1	⊙	0.1	− 0.3	− ⊙	0.1
Other	− 0.9	− 0.3	− 0.2	−0.3	0.2	0.1	− 0.3	− 0.1	− 0.1
Shortage	0.5	0.6	− 0.1	0.4	0.7	0.8	0.4	0.1	0.2
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Negative percentages represent excess percentage rerun over percentage produced.
⊙Less than 0.05 per cent. ‡No longer reported.
*Included with "Miscellaneous."
†Included with "Other Unfinished products."
Source: U. S. Bureau of Mines.

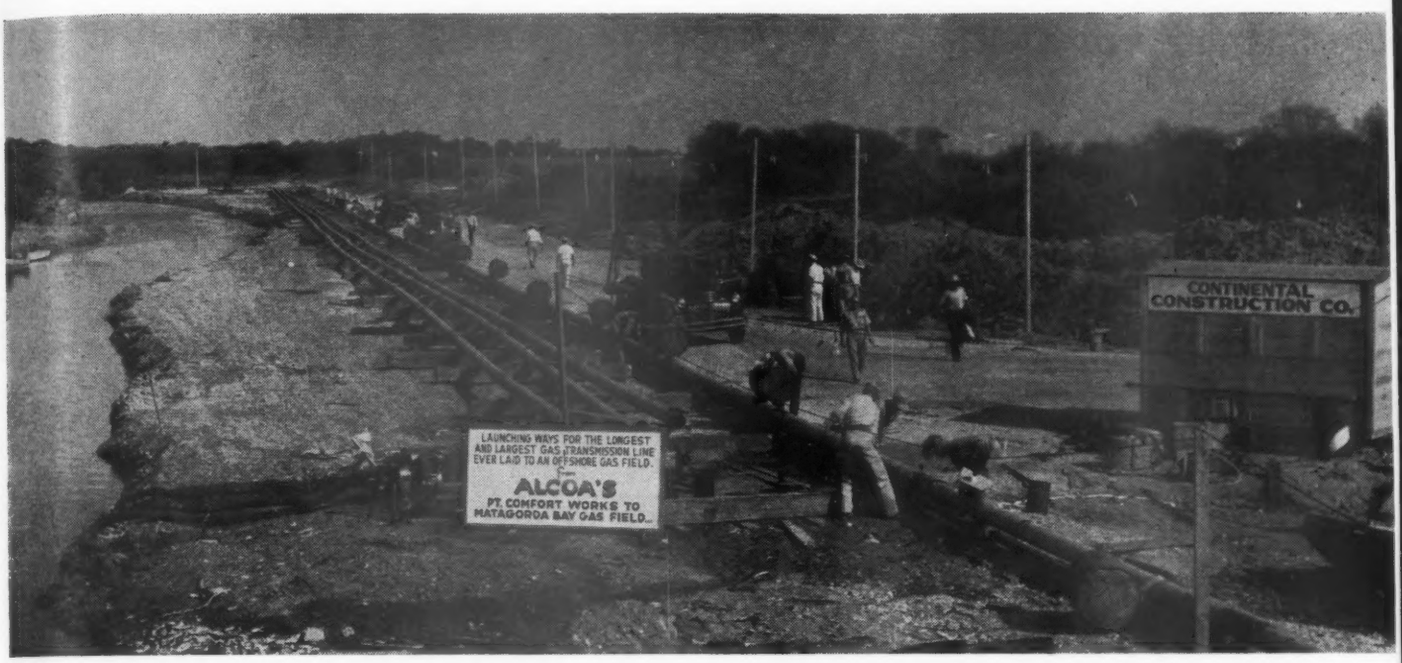
UNITED STATES CRUDE RUNS TO STILLS BY STATES, 1938-1947

(Thousands of Barrels)

State	1938	1939	1940	1941	1942	1943	1944	1945	1946 ℗	1947 ℗
Arkansas	9,950	10,696	11,257	12,686	13,636	13,091	14,211	14,857	14,947	16,285
California*	200,334	198,654	201,023	213,133	230,164	263,868	294,715	313,522	284,938	301,433
Colorado	1,773	2,563	3,120	3,661	3,769	3,627	4,062	4,320	4,676	4,649
Georgia†	2,165	1,679	2,597	2,533	762	505	1,863	3,249	3,516	3,737
Illinois‡	46,996	57,651	73,422	85,206	91,769	88,154	95,146	96,587	100,114	112,899
Indiana	67,452	75,536	75,454	79,144	77,898	83,017	87,202	84,797	87,901	95,021
Kansas□	46,912	46,913	49,340	57,651	59,933	57,924	59,548	61,076	61,106	67,917
Kentucky and Tennessee	8,034	10,359	13,100	16,398	17,101	16,862	17,276	18,916	17,934	18,745
Louisiana+	61,042	62,760	58,613	70,979	68,565	71,162	98,298	112,389	128,235	148,480
Maryland	12,525	12,614	13,024	14,004	8,461	11,048	17,249	20,362	18,204	20,224
Massachusetts and Rhode Is.	12,286	13,984	17,976	16,748	15,322	18,301	19,861	19,411	13,627	17,189
Michigan	15,556	18,711	24,400	26,013	27,753	28,049	27,814	27,273	25,473	28,632
Missouri	6,689	7,319	8,436	8,824	9,721	9,350	9,229	9,662	9,996	10,503
Montana	5,729	7,090	8,227	9,237	10,198	10,014	10,240	10,802	11,376	11,409
New Jersey	68,656	72,896	71,872	75,103	58,355	67,762	90,173	95,074	98,303	109,910
New Mexico	1,814	1,848	1,865	1,992	2,654	3,489	4,161	4,459	4,034	3,786
New York	15,720	17,644	22,060	25,002	22,574	20,615	22,672	25,686	28,348	29,125
Ohio	37,044	42,754	54,372	61,910	68,148	67,360	71,157	68,734	69,095	70,644
Oklahoma	57,542	58,177	57,071	60,655	59,728	56,893	64,329	68,438	67,283	74,630
Pennsylvania	93,539	100,717	106,424	115,322	89,803	107,833	136,902	141,102	145,437	148,692
Texas	374,829	399,233	399,725	429,892	375,133	407,992	491,920	487,927	503,431	521,606
Utah	2,874	2,804	3,215	3,838	3,838	4,167	5,358	5,780	6,877	8,468
West Virginia○	2,953	3,237	3,840	4,419	4,808	4,847	4,865	4,528	4,265	4,231
Wyoming and Idaho+	12,601	12,001	13,729	14,842	14,010	13,808	17,433	20,583	21,081	24,031
U. S. Total	1,165,015	1,237,840	1,294,162	1,409,192	1,334,103	1,429,738	1,665,684	1,719,534	1,730,197	1,852,246

℗Preliminary. *Includes Washington after 1938.
†Includes Delaware, South Carolina, Virginia, 1935—1945; South Carolina and Florida 1946, plus Delaware in 1947.
‡Includes Minnesota after 1938 plus Wisconsin after 1939. ○Includes Virginia, 1946—1947.
□Includes East Nebraska 1941; Nebraska and South Dakota 1942—1943; Nebraska 1944—1947.
+Includes Alabama 1938—1943; Mississippi 1939—1946, plus Alabama 1947.
+Includes Nebraska and South Dakota 1938—1940; West Nebraska and South Dakota 1941.
Source: U. S. Bureau of Mines.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.


LAUNCHING WAYS FOR THE LONGEST AND LARGEST GAS TRANSMISSION LINE EVER LAID TO AN OFFSHORE GAS FIELD.
ALCOA'S
PT. COMFORT WORKS TO MATAGORDA BAY GAS FIELD.
CONTINENTAL CONSTRUCTION CO.

General view of the launching ways when crew was tying on pontoons and making weld prior to launching. The other 3000 ft of 8⅝-in. pipe that will finish out this particular tow may be seen lying on the welding skids.

New Methods Used in Laying Line Offshore

SAMMY COLLINS

THE laying of the Lavaca Pipe Line Company's gathering system and transmission line in Matagorda and Lavaca bays marked several milestones in the future development of offshore gas reserves. The project was planned to supply fuel to the Aluminum Company of America's new $30,000,000 reduction plant on Point Comfort near Port Lavaca, Texas. This is the first peacetime use of natural gas for fuel to generate the enormous amounts of electricity needed in the electrolytic process that reduces alumina to aluminum pig. Alcoa heretofore has used water power exclusively for current generation.

The development of a vertical-crankshaft, radial-type, spark-fired, gas engine made the use of natural gas for fuel economically feasible. Drawing board theory plus actual tests indicate that this new method of current generation may be cheaper than either hydro-electric or steam generation of power.

There will be 120 of these 1500-hp engines, which are installed with a 1100-kw generator connected directly to the vertical crankshaft of the engine to develop a total of 132,000 kw. The direct current thus generated will be used to burn carbon electrodes in a cryolite catalyst and alumina solution, which reduces the alumina to metallic aluminum.

Economy Observed

In planning the gas transmission project economy was observed in every phase in order to keep the initial investment as low as possible.

The project consisted of eight important phases: (1) Unloading and racking of pipe from barges and railroad cars, (2) wrapping and coating, (3) welding, laying, and testing, (4) construction of a piling and creosote timber metering platform in Matagorda Bay, (5) installation of control and metering equipment at each well and on the metering platform, (6) installation of shore control and metering station, (7) laying of the 1700 ft of 8⅝-in. land line and constructing the shore approach and

EXCLUSIVE

THE AUTHOR

Sammy Collins was born in Beaumont, Texas, July 27, 1913. His family moved to Big Spring, Texas, in 1929, and, after being graduated from high school, he began work in the oil fields. His experiences were varied—pipeliner, roustabout, roughneck, gang pusher, tool pusher, drilling superintendent—until 1944 when he became partner in Collins and Black, an oil-field construction company. The firm was dissolved and 1945 and he formed Collins Construction Company to do oil-field and municipal utilities construction work. He still owns this company. The Continental Construction Company, Inc., was formed in 1947 by W. H. Bauer, Collins, H. C. Smith, and J. C. M. Cryer, to service marine oil-field accounts. Collins is vice president in charge of operations.

thrust block system, and (8) final connection and testing of the complete system as a unit.

The pipe, consisting of 60,000 ft of 8⅝-in. OD, 27-lb seamless tubing; 36,000 ft of 4½-in. OD, 10.89-lb seamless tubing, and 22,000 ft of 6-in. OD, 19-lb seamless tubing, was shipped by barge to take advantage of low freight rates. The barges were docked at Continental Construction Company's pipe yard in Port Lavaca, where the pipe was unloaded and racked. Continental, whose headquarters are in Port Lavaca, was awarded the contract for cleaning, wrapping, doping, and laying the line. The wrapping and doping of the line was subcontracted to Rosson-Richards of Corpus Christi, Texas. Rigging up began immediately as 26 working days were specified as the allowable time for the 11½ miles of 8⅝-in. pipe in the main transmission line.

The coating and wrapping materials and machinery were hauled to the Continental's pipe yard and the machinery was set up by Rosson-Richards. The equipment was installed near the pipe racks to eliminate unnecessary handling. The pipe coating consisted of one coat of primer, one coat of enamel, a wrapping of glass fiber, another coat of enamel, another wrap with glass fiber, and a finish wrap of kraft paper. The pipe was cleaned and primed by one machine and coated and wrapped by another. The coating material was heated by natural gas from a city main nearby. Long, padded racks were built on an upward incline to facilitate loading of the wrapped pipe on trucks for transporting to the launching ways. The long racks were utilized as storage space when the pipe was wrapped and coated faster than the trucks could haul it away.

Looking from highway bridge toward Matagorda Bay. The pipe is floating on pontoons as the towboats wait for another section to be welded on.

New Procedure

Up to this point, usual pipe line procedure was followed but now a marked departure from accepted practice was begun. The usual way to lay pipe line underwater is to weld the pipe into double or triple joints and load it on a barge. The barge is then towed to the location and these long joints are welded, one at a time, as the barge is slipped ahead and the pipe pays off the stern of the barge. For a successful barge laying operation, the crew must have reasonably protected waters, and, even so, barge pipelining is a slow and costly procedure. Due to the strong currents, heavy seas, shortage of time, and the expensive nature of a barge pipe laying operation. Continental Construction Company felt that a quicker, easier, safer, and cheaper method could be devised.

Our first thought was that we could make up long strings, probably 1000 ft at a time, and tow it to its place and weld on to the pipe already laid. We then decided that if we could take one 1000-ft section, we should try to take two 1000-ft sections.

After we had definitely decided on long tows, the problem arose of launching the long section. We rented a 1200-ft length of swampy land alongside Lynn's Bayou, a narrow, shallow, crooked little creek that empties into the Port Lavaca Harbor. The mouth of the creek was more or less lined up with the Intracoastal Canal. The mouth of this creek is directly under a small bridge, over which passes the Port Lavaca-Palacios highway.

We moved in a ½-yd dragline and proceeded to start widening and deepening the creek. We planned to weld the sections into 1000-ft lengths along the bank of the creek, then set the pipe in the water, sideways, and attach the necessary pontoons. The creek was widened and deepened quite a lot but the swampy, mushy quicksand kept seeping in almost as fast as it could be dug out. We were piling the quicksand along the creek banks and spreading it. In this manner we finally raised the swamp land until it was reasonably dry. This work was carried on 24 hours a day but it was soon apparent that we were spinning our wheels. The wrapping and doping crews were far ahead and would soon have to be shut down for lack of storage for the finished pipe.

Launching the Pipe

After much discussion, we decided to attempt to launch the pipe endways and try a method used by boat launchers for many years.

We strung 8-in. by 10-in. sills, 12 ft

Some of the crew picking up launching dollies at the end of launching ways. In foreground is a view of one of the large cast iron weights used on 8-in. pipe. This is a night picture as launching time was 10 p.m.

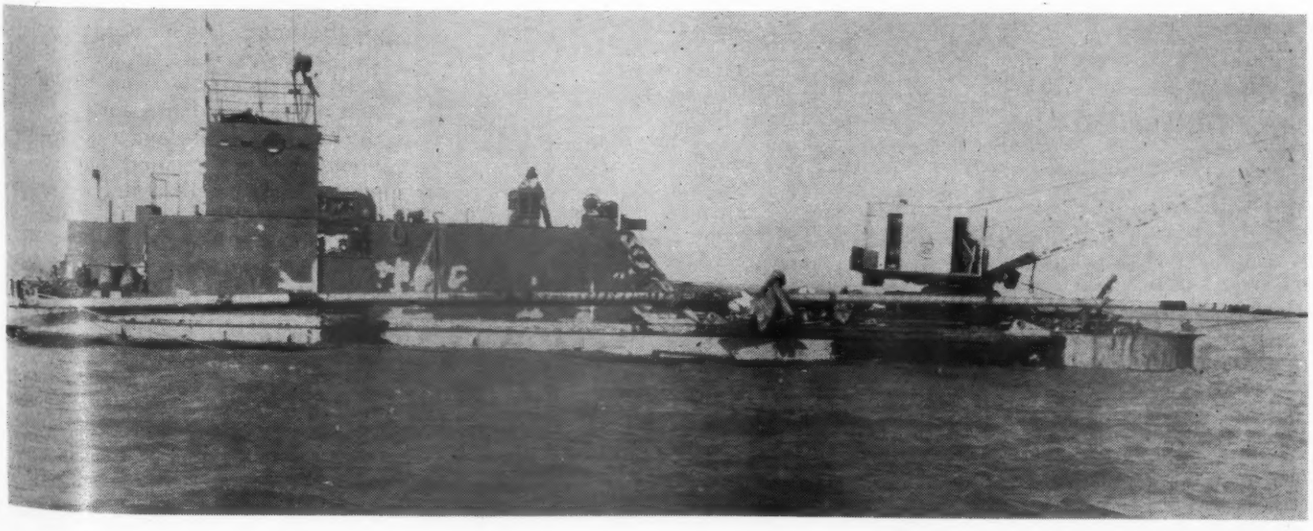
long, along the bayou, on land, as welding skids. This was done after putting about 1 ft of dry earth all along the area and topping this fill with mudshell to stabilize the soil. Then we began building wooden launching ways 1000 ft long. These ways were built exactly like a railroad track, using 3-in. by 8-in. board road timbers, 4 ft long for ties and 4-in. by 4-in., smooth on all sides, straight and free from knots, for the tracks.

Pipe was hauled from the wrapping and doping yard to the launching area where it was strung on the 8-in. by 10-in. sills. Welding the pipe into 1000-ft lengths was begun immediately. As soon as the sections were completed, they were subjected to a 1000-psi cold water test. The new welds were then wrapped and doped and finally the coating was tested for holidays. Every 330 ft we clamped a cast-iron river weight weighing 1100 lb around the 8⅝-in. pipe. The purpose of the weight was to keep the pipe on bottom as it weighed 27 lb per ft on shore and would weigh only 3 lb per ft when submerged with the ends sealed.

While the above work was going on, we were still busily engaged in building the launching ways and constructing wooden dollies to slide on the 4-in. by 4-in. rails. These dollies were made of 2-in. by 6-in. and 2-in. by 4-in. timbers using the 2 by 6's to slide on and the 2 by 4's as bracing and guides. The dollies were similar to snow sleds gliding along wooden tracks instead of snow. When the tracks were finished and the dollies built, we carefully cleaned the tops of the 4 by 4's and doped them with a light, flowing tallow. Tallow was used to prevent gumming and sticking. We considered using bananas for lubrication but decided that they were too expensive.

The dollies were spread out on the track, spaced about 40 ft apart, and the first section of pipe was picked up with a revolving boom tractor and carefully placed on the dollies. The front end of the pipe was plugged with a coupling and a standard bull-

Side view of the workship Faye as a main line weld of the 8-in. is made. The welder is working on an outrigger platform about 4 ft from the ship's deck. To prevent possible damage to the coating the pipe was not allowed to touch the ship.



plug to seal the ends and facilitate removal at sea prior to welding.

For pontoons, we had purchased 200 used oil drums, welded and reinforced them at suspension points, and plugged the bungs, using cast-iron plugs and sealing compound for this purpose. Suspended from the drum was a 2-ft length of ¼-in. by 8-in. heavy canvas belting with ½-in. brass grommets through which a 6-ft length of ½-in. manila rope was spliced. Small cleats were made and welded to the sides of the barrels to the ½-in. ropes around. These cleats, placed on the sides of the barrels, enabled us to untie the ropes easily when we wished to lower the pipe to bottom.

The pontoons themselves presented many problems most of which were solved by the single barrel method. Barrels welded into doubles were tried but were definitely unsatisfactory. Our calculations showed that a 55-gal oil drum could support 485 lb fully submerged. We decided on a 300-lb barrel loading but were finally forced to use a 200-lb loading per bbl or less. At this weight the barrels were most efficient. With heavier loads the pipe sagged between pontoons, the barrels towed heavily, and were subjected to heavy waves and swell action that sometimes ripped the fittings from the pontoons.

Getting back to the lauching, we left the pipe on the ways ready for pontoons. The pontoons were attached to the line at regular intervals and five extra pontoons were placed at each weight. The pontoons were fastened securely and each pontoon had a small marker buoy tied to it with fishing cord so a pontoon could be found if it sank.

A life jacket was attached to a 1½-in. tow rope 50 ft long, and this tow rope was attached to the forward end of the pipe. Another 1½-in. by 50-ft tow rope was attached to the pipe near the other rope but the end of this rope was passed to the two waiting 225-hp tow boats. Two winch trucks were tied alongside the pipe on the racks and their winch lines were attached to the pipe. The revolving boom was also tied to the pipe and everything was made ready for launching.

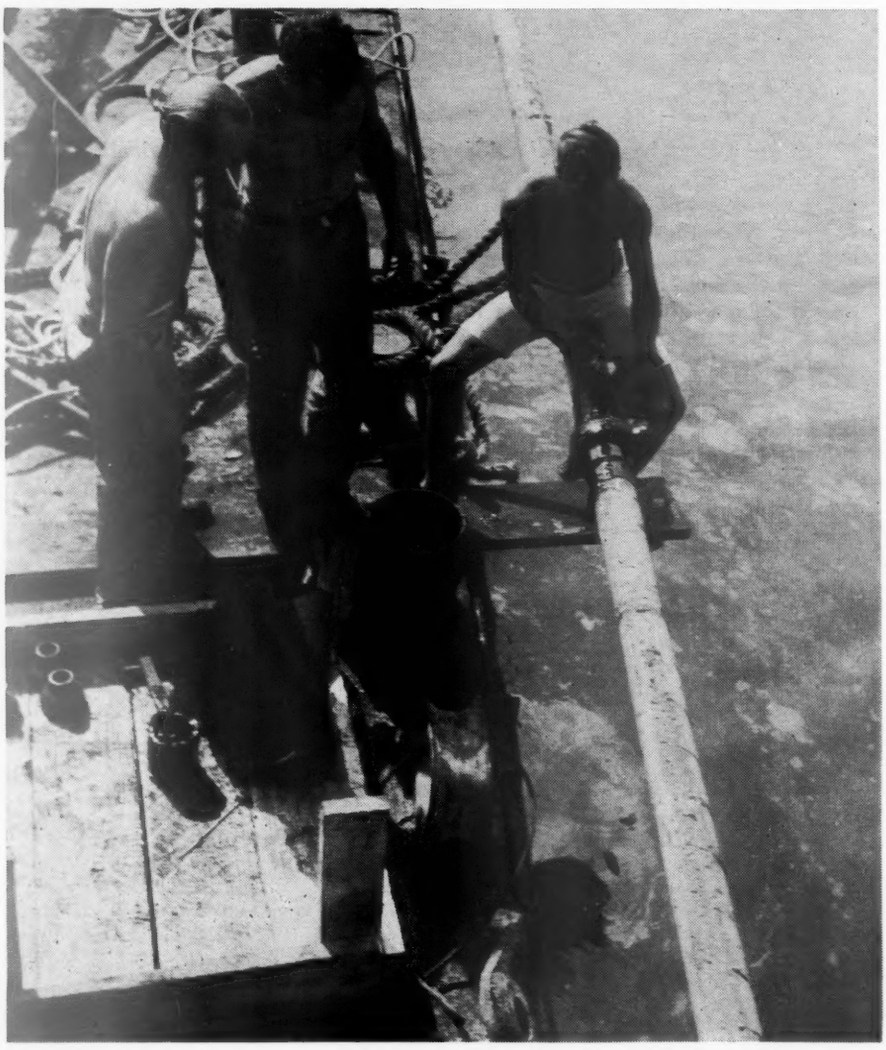
We had set up a public address system on the highway bridge above the launching ways and had a signal light hooked up with amber, red, green, and violet lenses. These devices were made necessary by the long distance from end to end of the work and the necessity that all phases of the operation be working as a single unit. Two-way radios were used to keep contact with the tow boats.

At the given signal all units pulled together and the first section was on the way. So easily did it pull that we were amazed. We immediately removed the truck winch lines and let the revolving boom and tow boats pull the pipe on out at about 3 mph and as the tail end of the pipe approached the end of the launching ways the slow signal was given, the tow boats eased up, and the revolving boom stopped the pipe. As the pipe entered the water the dollies would float to the surface of the harbor where we picked them up with a rowboat and returned them to the end of the launching ways. From this point the dollies were loaded on a truck and quickly returned to their place along the ways. The revolving boom set another 1000-ft section on the dollies, lined it up with the section just launched, and the welders welded the two sections together. We put four beads and a lace on this joint as there was no way of testing this particular weld. A further precaution was a small can buoy attached to each of these sectional, untested welds so that if a leak should develop on the final test, ordinarily we could expect to find it at one of these buoys.

While the welder was making his weld, the rest of the crew were attaching pontoons to this second section. By the time he had his weld completed, the pontoons were all in place, the joint was quickly wrapped and doped, and we launched this time with just the two tow-boats and the revolving boom. In this manner, five sections were joined together and we decided that a 5000-ft tow would be about all that we could handle satisfactorily as the wind was breezing up. We placed a coupling and a bull-plug on the open end of the last section, sealing the pipe. We then put a 50-ft tow rope on the end and attached a life jacket so that if it were necessary to guide the tail end of the pipe, we would have a tow rope by picking up the life jacket.

The towing of a mile long section of a 8⅝-in. pipe, having a total dead-

Sammy Collins and David Carr, ship engineer, watch Bill Hensley wrap a connection with a new type glass cloth that does not irritate the skin.



weight in excess of 80 tons, in rough, unprotected, current-riden waters turned out to be somewhat of a feat in itself. The first section was floating by mid-afternoon of the first launching day and the southeast wind was blowing from 20 to 25 mph, causing considerable difficulty.

As we began laying the pipe at the nearest point, we were only seven miles from where we could take off the pontoons and lower the line to the bottom. This first tow, together with launching and laying, consumed 33 hr.

We expected trouble on this tow, because no previous experience was available to use as a guide, and many of our theories had to be discarded during the first night and following day. All profited by these errors, however, and those first 33 hr saved us many trying experiences later.

One of the things learned on that first trip was that the pipe should be at the laying point before noon, in order that we could finish our water weld before the sea became built up by the high afternoon southeast winds. We considered ourselves fortunate on the first tow because we did not have to make a weld.

We took the following night off to let the crews rest up for the long stretch ahead and made plans for launching to start at 10 p.m. the next night. This launching was accomplished with little difficulty, being completed in 4 hr, or an average of 1 hr for each 1000-ft section. We took only four sections this trip as we were just a bit apprehensive about the first water weld.

Main Workshop

Continental Construction Company's main workship, the *Continental Faye*, is a converted LCT with two 225-hp Gray marine diesels for propulsion, two 10-kw d-c generators for electric power, lights, pumps, battery chargers, etc. Accommodations are available for sleeping 25 men and a galley capable of handling up to 50 men. This ship is equipped with a two-way radio for ship-to-ship and ship-to-shore communications. It also has a crane with a 45-ft boom that travels up and down the 105-ft decks of the LCT and is used for hoisting and pile driving. All that was necessary to add to her for pipe laying operations were two outriggers on her starboard side, one on the bow and one on the stern.

Standard procedure after the first tow was to launch the pipe with one 255-hp towboat, keeping the other towboat at the dock for radio communication and to relay instructions. As soon as the pipe was launched, the other towboat would proceed to the front of the tow and tie on to the other boat, thus adding her power. Then we would take the LCT *Faye* out in front of them and pass a line to the lead towboat, adding another 450 hp and increasing the speed of the tow by 100 per cent.

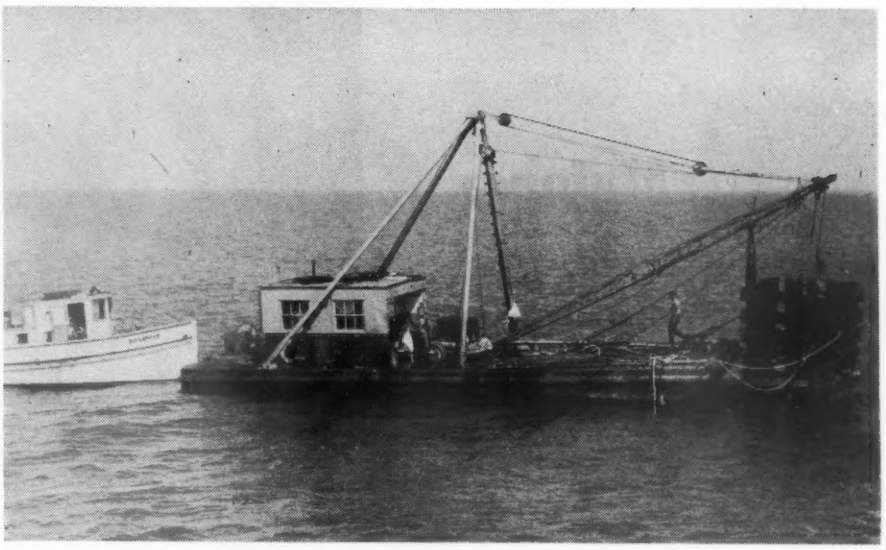
When we sighted the life jacket at the end of the previous tow, we cut loose with the *Faye* and proceeded to anchor out and pick up the previously laid pipe, holding it in place with the stern outrigger and securing lines. By the time all this was done, the tail end of the pipe would be approaching the spot where we were waiting to make the weld. We would radio the front tow boat to release her line and come to the tail. The other towboat left at the front of the tow would begin getting into position and lining up the line according to our radioed instructions. The free tow boat would pick up the tow line on the tail or stern end of the pipe and bring it to a point where the workship crane hook could be attached to this tow line. The crane then swung the pipe into position and an outside clamp was placed on the two ends of the pipe for alignment. A hoist attached to both lines held the two ends together. The crane's boom would be lowered and the machine walked as far forward as possible. The crane would then hold the pipe up out in front to help align the sections.

While the welder was making his weld, the towboat out on the front of the floating section would work the line into its final position, tie a small anchor on his tow line, and throw anchor and tow rope over the side, holding the pipe in place by means of the anchor. The tow boats would congregate at the *Faye* at dinner time and as soon as everyone finished eating, the towboats started removing and picking up the pontoons.

When the weld was finished and cooled, one coat of primer, a coat of enamel, a wrapping of glass fabric, a final coat of enamel, and a felt cover were put on the field joint. A can buoy to mark this weld as "untested" was tied on the pipe and it was lowered to the bottom.

The 8⅝-in. pipe was all in place 25 working days after we were awarded the contract, one day inside the specified time. Ten days were spent in rigging up before the first section was launched.

We moved right into the 6-in. with no loss of time and solved the few new problems with little difficulty. There were no weights to put on the 6-in. pipe but the smaller pipe was more flexible and more difficult to tow and handle. By this time our towing distance was nearly 20 miles. From 10 p.m. launching time through our return to port next evening our time was divided about as follows: Launching, 5 hr; towing, 5 hr; welding, 3 hr; removal and recovery of pontoons, 3 hr; return to port and unload, 4 hr; supplies, fuel, water, and repairs to



Small derrick barge, making final tie-in at one of the gas wells. All of the protection structures were of the same general design.

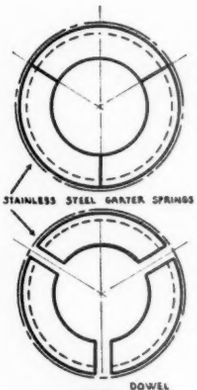
Launches New Tanker

From Belfast, comes the report of the recent launching of the motor tanker *Borgny*, building for Fred Olsen and Company, Oslo, Norway, by Harland and Wolff, Ltd. Of 12,000 deadweight tons, the *Borgny* has the following dimensions; Length, 487 ft overall, 460 ft bp; breadth moulded, 59 ft; depth moulded, 34 ft 10 in.

Maloney Rod Packing

MALONEY BAKELITE COMPRESSOR PART

Maloney Rod Packing, the perfect non-scoring, non-wearing rod packing, is ma with three different grades of Micarta — HY-TEMP, GRAPHITIZED and SUPER. Ea grade plays a definite part in preventing loss of compression and prolonging t life of the compressor rod.



◀ TYPE A — BREAKER RINGS

Located in the packing groove closest to the cylinder, and made of heat-resistant HY-TEMP Micarta constructed to resist the first rush of hot gas from the cylinder. HY-TEMP withstands temperatures up to 400°F., but is not recommended where **sustained** temperature exceeds 350°F.

◀ TYPE B — RADIAL RINGS

Made from Maloney GRAPHITIZED Micarta, properly impregnated with graphite, the Radial Ring helps lubricate the rod. Even if the lubricators fail, the rod is in no danger of becoming scored or worn.

◀ TYPE C — BRIDGE RINGS

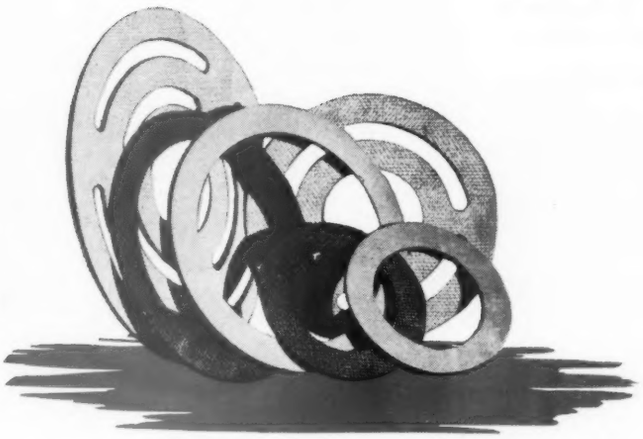
Made of Maloney SUPER Micarta, the Bridge Ring prevents loss of compression. It works hand-in-hand with the Radial Ring, one of each in every packing groove. A Bronze Dowel Pin in the Bridge Ring engages the gap in the Radial Ring, preventing the lining up of the gaps in both rings, but permitting compensatory wear of the rings.

◀ TYPE D — THREE-PIECE RINGS

Perhaps a pair of 3-piece rings (Type D) will be preferred to the Radial and Bridge combination. If so, this ring can be furnished in SUPER, GRAPHITIZED, or HY-TEMP. A Bronze Dowel Pin on one ring engages the gap on the companion ring to prevent gap line-up. One SUPER Ring with one GRAPHITIZED Ring to each packing groove makes a thrifty, long-wearing, protective combination.

All Maloney Rod Packing Rings come equipped with Stainless Steel Garter Springs.

Maloney Compressor Valve Plates



FFER DEPENDABLE OPERATION . . .

WE CAN MAKE IMMEDIATE DELIVERIES OF BAKELITE COMPRESSOR VALVE ATES IN ALL SIZES AND FOR ALL MAKES OF GAS COMPRESSORS upon receipt either dimensioned drawings or samples (worn or new).

We can supply these Valve Plates from either Super Bakelite (for tempera- es up to 250 degrees F.) or Hy-Temp Bakelite (for temperatures up to 400 de- ees F.) Orders should always indicate maximum temperature to be encountered.

Many thousands of these Bakelite Valve Plates have given complete satisfac- n in refineries, pipe lines, and gasoline plants, supplanting stainless steel and rbon steel plates.

They are all ground exactly parallel and ready for installation when they leave r plant.

How to Order Rod Packing

Give us number of breaker ring grooves and number of packing ring grooves per set. Show type of packing ring desired (Types B-C or Type D), and operating temperature.

F. H. MALONEY COMPANY

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fleet, 4 hr, and launching time again. So it can be seen that 24-hour-a-day operations were absolutely necessary.

Metering Platform

All 4 and 6-in. pipe was laid for gathering lines to the location where we planned to build the metering platform. Salt Dome Oil Company had a drilling barge in the area and just as we finished laying the gathering lines, this rig discovered a new section of Matagorda Bay that was productive of gas. The discovery threw our gathering system out of balance as the metering platform was on the wrong side of the bay, and if its location was not changed critically short supplies of pipe would delay tying in new wells beyond their respective lease forfeit dates.

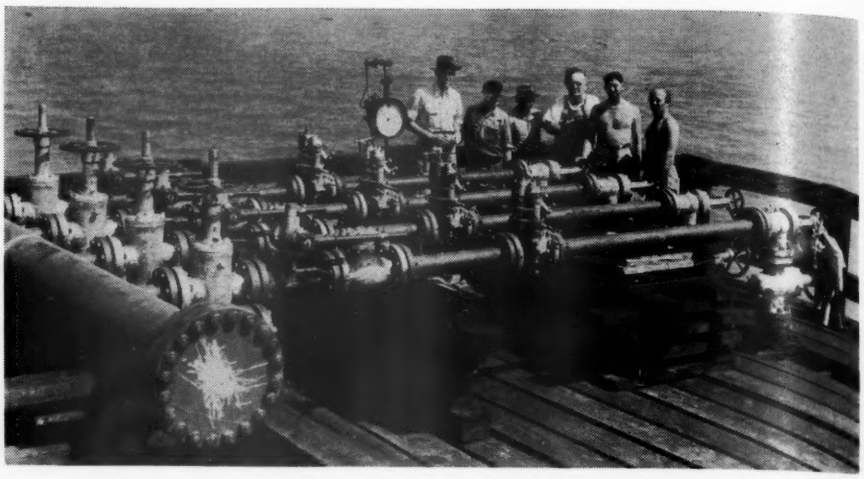
After much discussion with Alcoa officials it was decided to change the location of the metering platform to a more advantageous position, entailing the raising and relaying of all the gathering system.

We drove the piling and framed the metering platform in the new location and proceeded with the task of raising and relaying the gathering system. This work took the better part of six weeks and lease forfeit time was becoming dangerously near.

The new pipe was on hand and we laid it in short order without any unusual troubles. We then began the tremendous task of connecting all wells into the metering platform, installing control equipment on each separate well, and assembling the meter runs.

Control and metering equipment was designed and supplied by Maintenance Engineering Company of Houston, Texas. That company's engineer, George Moore, did an excellent job of design and further he came to the field and personally supervised installation of this equipment.

Each well is equipped with a high pressure regulator, which reduces the well pressure from 2100 to 800 psi. The complete system will carry 800-psi flowing pressure. The 800-psi gas leaves this regulator and is passed through another regulator, which will shut the well off in case of a flow line break or a sudden pressure drop. From the control equipment, which is mounted on the piling and timber protection structure around the well, the gas is introduced to the flow line through three marine type joints. These joints absorb the wave action movement of the christmas tree, structure, and flow line. One of the joints is tied on the flow line at the bed of the bay. Another is installed above the water level and the third is connected to the control equipment. Control equipment attached to the structure is connected to the tree with high pressure flexible tubing to absorb the separate movements of the structure and the tree.



View of metering platform in the Bay, with one-half of the meter runs installed. The men are: George Moore, left, Maintenance Engineering Corporation, Fred Trees, connection foreman, one of the crew, J. F. Collins, connection foreman, R. L. Daerr, Alcoa's time checker and inspector, and Sammy Collins, the author and vice president of Continental.

At the metering platform in the center of the gas field the same procedure is followed in coming out of the water to the meter runs. The meter runs are all parallel and each ties into a 12-in. header. At the metering platform the gas passes through an adjustable choke, a block valve, the meter run, to a quick change orifice fitting, a bleeder valve, and a final block valve. The gas then enters the 12-in. header. The gas leaves this header and enters the main via three 8-in. marine type joints, thence through the 6-in. and 8-in. main line to the shore control station.

The 8⅝-in. main line approached the shore in very shallow water and had to rise over a 25-ft bluff. We dug back in the bluff 55 ft and brought the line to elevation by using two 45-deg. tube turns. Thrust blocks of concrete were poured solid around and underneath these tube turns and the line was covered with a solid block of concrete for 50 ft out into the water. This design was used to prevent the movement of the pipe from wave action, scouring, etc.

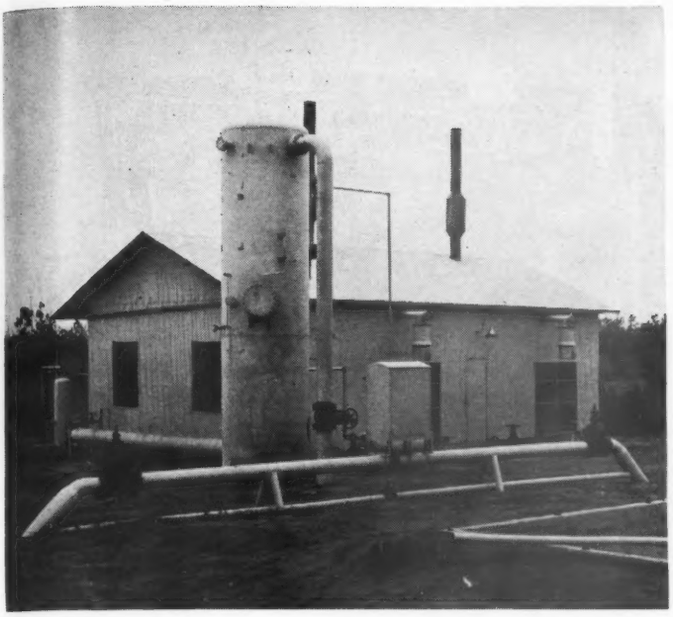
Shore Control Station

The shore control station consists of a high pressure separator to remove condensation, and two parallel meter runs for regulation and stabilization of pressure on the plant system. The pressure is dropped from 800 to 40 psi as it leaves this control station to travel the final 3000 ft to the plant site proper.

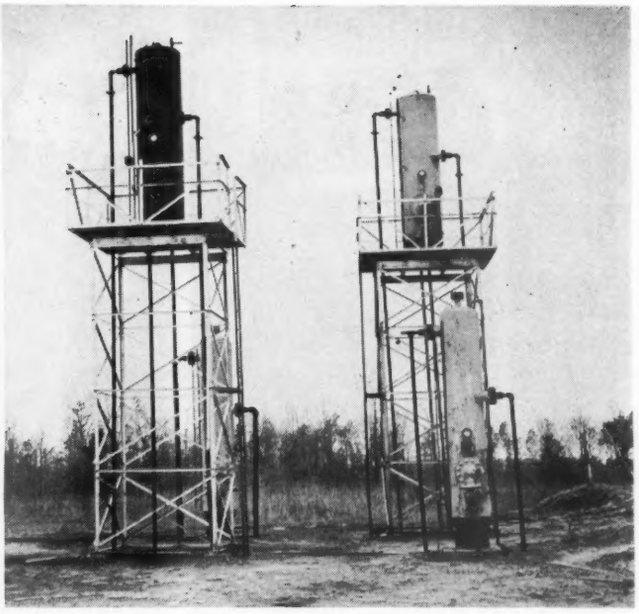
At each well and at each meter run, every line has a standard insulating flange. Magnesium anodes will be attached to these lines to eliminate the hazard of electrolytic corrosion.

The gas was truned into the system at midnight, November 14, 1948, and tests were made throughout the following days. There were eight leaks, six due to faulty pipe and two to pinholes in welds. These leaks were quickly repaired. At this point, we were immediately aware of the value of the 1000-psi cold water test, made while the pipe was still ashore, where small leaks could be repaired at a minimum cost and under ideal conditions.

During the course of the job, we made up 700 barrel pontoons and when the job was over we had 200 good pontoons still in use. We felt that some better method of floating this pipe into place should be devised. We immediately began discussing and planning a new system. We have completed research and are assembling new equipment for our new marine pipe laying system. The new method will enable us to lay 3 miles or more of pipe per day with the launching ways and the barrel pontoons eliminated. We have completed all the tests under adverse conditions in Matagorda Bay and hope to use the new system in a Gulf of Mexico installation in the near future. The time and labor saving effected in this new system naturally will lower submarine pipe laying costs and in addition will further protect the coating, which is a most important consideration in laying a submarine pipe line. ★★★



Exterior of Macedonia compressor station building, one of two stations on the system. The other is at Dorcheat.



Elevated well separators result in increased recovery of hydrocarbons due to the greater drop in pressure.

VACUUM GATHERING SYSTEM

FRANK H. LOVE*

RECENT installation of a vacuum gathering system in the Dorcheat-Macedonia field, Arkansas, by the Arkansas Fuel Oil Company, accomplishes four results: (1) Conservation of gas; (2) increased recovery of hydrocarbons; (3) stabilization of crude with resultant reduction in evaporation loss, and (4) increased volume of residue gas for commercial consumption.

Since 1943, when its Columbia Gas Treating Plant was placed in operation, Arkansas Fuel has been taking wet gas produced with oil from operators in the field, extracting the hydrocarbons, and putting the residue gas into lines of the Arkansas Louisiana Gas Company, an affiliate, for distribution to commercial consumers.

Originally the extraction plant and field gathering lines were designed as a high pressure system, the latter operating at a pressure of 600 psi. As producing sands became depleted, however, and well pressures declined to a point where the gas would not enter the system, a 300-psi gathering system was provided. As pressures declined further, a 125-psi system was installed, and now, with the pressure of many producing wells so low that even 125 psi is too great, an atmospheric or vacuum system has been provided. All four systems are in operation, taking gas from wells in accordance with the available pressures, assuring state conservation authorities that almost every cubic foot of gas is being utilized. Until the vacuum system was installed late in 1948 gas available at very low pressure had to be wasted in flares.

As a part of the vacuum system two compressor stations have been constructed, one in the Dorcheat and one in the Macedonia part of the field. Incidentally, these were originally considered two separate fields, but subsequent drilling proved them to be one continuous producing area, consequently the names have been combined and the area is now known as the Dorcheat-Macedonia field.

At Macedonia two 225-hp, V-angle type compressors are in operation, pulling 10 in. of vacuum at suction and two-staging the gas to a discharge pressure of 65 psi.

At Dorcheat there is a 150-hp compressor unit of the same type, compressing the gas in a single stage from 10 in. of vacuum to a discharge pressure of 35 psi.

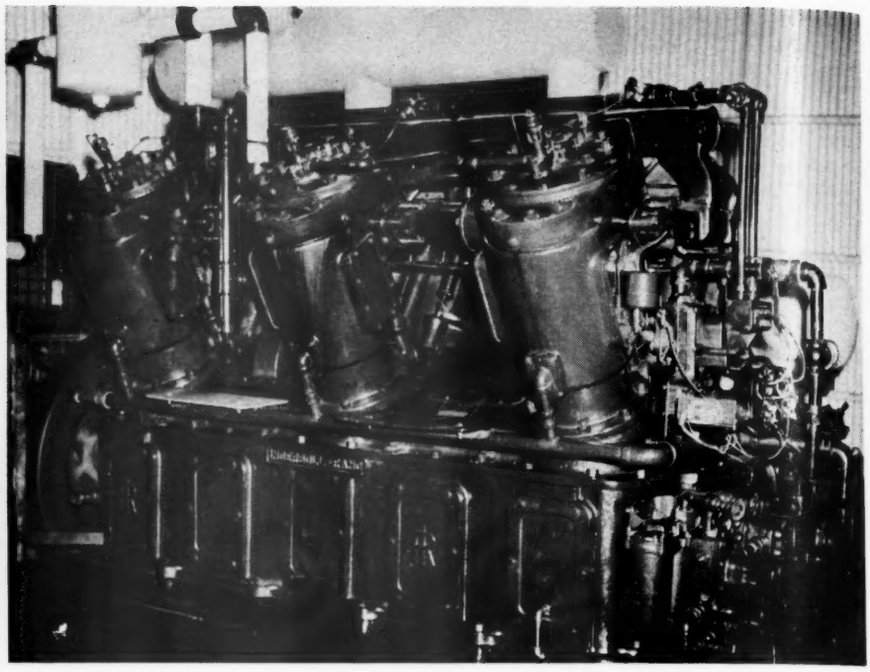
The compressor stations are set on the main lines to the Columbia Gas Treating Plant and discharge into the low-pressure or vacuum system.

Gathering lines from the wells to the Dorcheat station consist of 6-in., 8-in., and 10-in. The vacuum system line from this station to the extraction plant is an 8-in. Gathering lines to the

*Pipe Line and Marine Transportation Editor.

EXCLUSIVE

Radiator type fans are used to cool the engine jacket water.



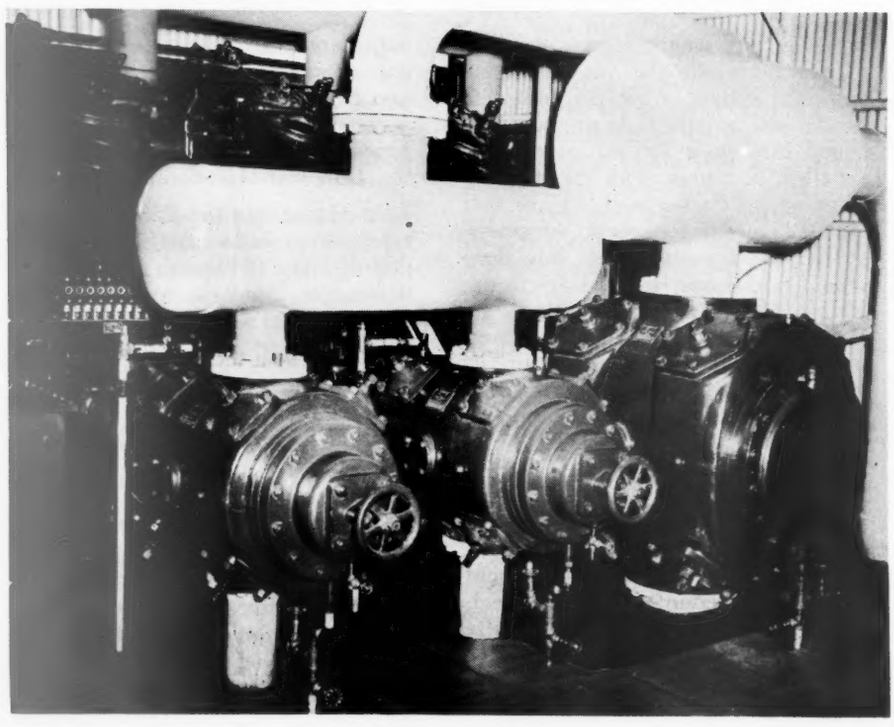
One of the two 225-hp, V-angle type compressors installed at Macedonia station. At Dorcheat there is a single 150-hp unit of the same type.

Macedonia station are 6-in. and 8-in., and the vacuum system lines into the plant are two 6 in.

Although operated on a 24-hr basis, the compressor stations require minimum personnel. Only one operator is necessary on each 8-hr shift to keep both stations running.

Installation of the vacuum system puts about 2,250,000 cu ft of gas a day through the Columbia plant that otherwise would be wasted, and about 75 per cent of this volume finds its way into the distribution system as residue gas after the other 25 per cent has been removed as hydrocarbons. This is not the complete story, however. It is of interest to note, and of considerable value to Arkansas Fuel Oil Company, that the recovery of hydrocarbons in the vacuum system approximately trebles what it would be in the 125-psi system. This results from a drop in pressure effected by the use of elevated separators at the wells, from which the wet gas is pulled into the compressor stations.

The station at Macedonia compresses the gas in two stages from a suction of 10 in. of vacuum to a discharge pressure of 65 psi.



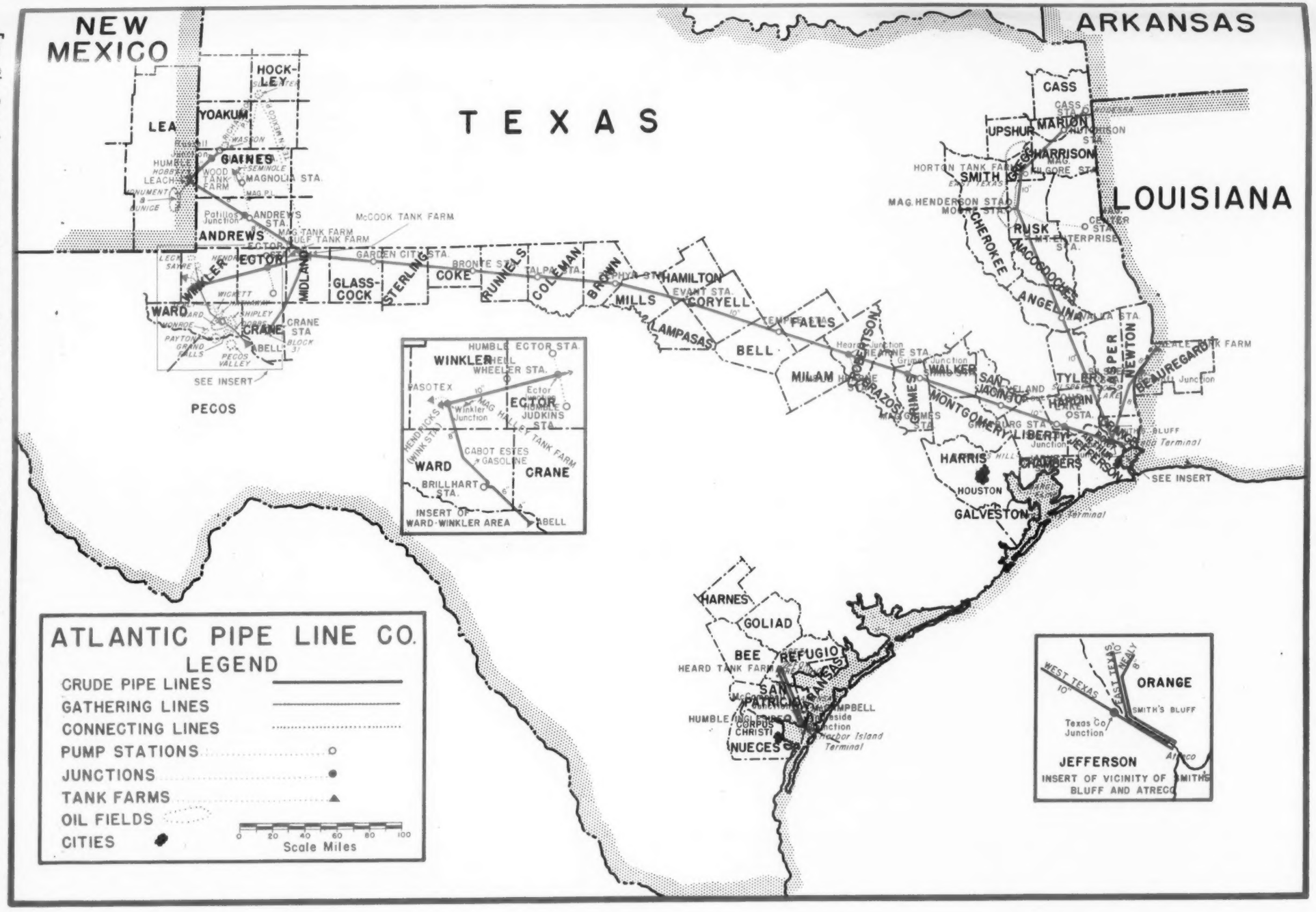
Wells in the Dorcheat-Macedonia field consist of those producing sweet and sour crude oil and condensate. Gravity of the crude oil varies from 40 to 50 deg API, and that of the condensate from 50 to 70 deg API.

Gas is being taken by Arkansas Fuel Oil Company from 19 operators in the field. Arkansas Fuel itself owns only one well.

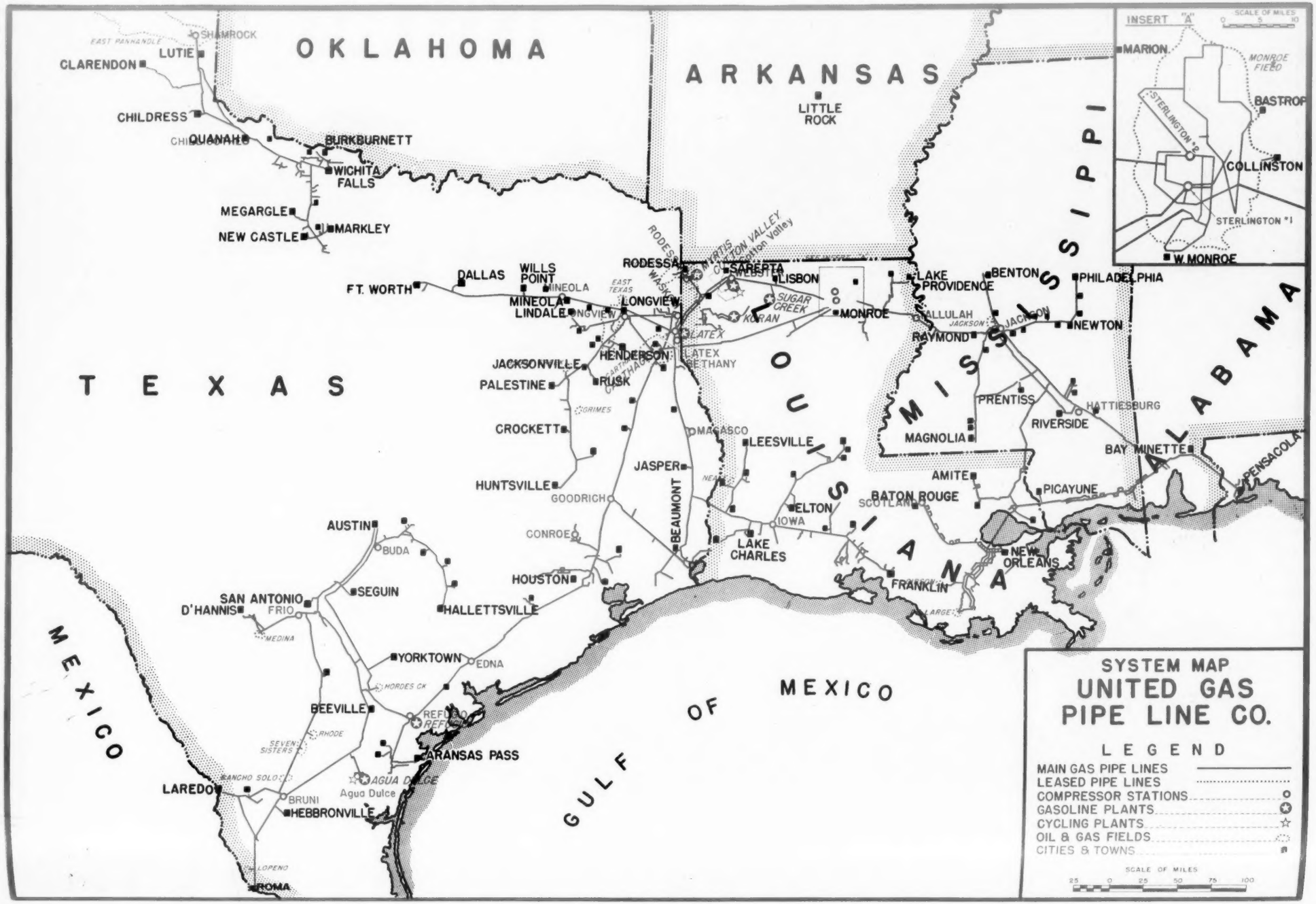
The vacuum system at present is connected to 32 wells, owned by eight operating companies, although it is available to all 19 companies as needed. All gas now going to the system is sweet.

Sweet gas wells in the Cotton Valley Series produce from depths varying from 6700 ft to 8800 ft, and from sands varying in thickness from 1½ ft to 150 ft. Gas-oil ratios also vary widely, in some wells being 500 cu ft of gas to 1 bbl and in others 75,000 cu ft to 1 bbl.

Sour gas wells produce from the Reynolds Lime at depths of approximately 8900 ft. The gas-oil ratio of the wells approximates 25,000 cu ft of gas to 1 bbl of oil. ★ ★ ★



From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.



From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

Accurate Wide Range Metering of Natural Gas*

L. K. SPINK†

● **Abstract.** This paper discusses two problems in the measurement of widely varying flows with the differential type meter.

First is the measurement of rapidly fluctuating flows. Damping of the meter response and various methods of reducing the amplitude are discussed.

Second problem is that of obtaining readability of low flows without overranging at high flows. Several devices for accomplishing this with the differential type flow meter principle are discussed.

● **Introduction.** The differential type of flow meter, although it has many qualifications that are desirable for measuring large volumes of gas, has certain limitations. This paper will discuss two of these limitations and means used to overcome them. Both arise from the fact that the differential type flow meter is inherently a rate measuring device. Total flows are obtained by secondary operations such as computation of charts or automatic integration of the meter readings.

● **Problem 1, Measuring rapidly varying flows.** Because the rate of flow bears a square root relationship to differential, on widely varying flows, rates obtained from average differentials will be inaccurate. That is the square root of the average is not the same as average square root.

A very casual examination of the problem might lead to the conclusion that the uniform flow scale type of meter that extracts the square root of differential and records this square root on the chart could be damped so as to read an accurate average of rapidly fluctuating flow, but this is not the case with existing mechanisms, because, due to the mechanical means for extracting the square root, the rate of response is not the same at high flows as at low flows.

Therefore, the accurate operation of the differential type meter is limited to flows that are changing slowly enough so the instrument can follow them with reasonable fidelity. Also, if the total flows are obtained by computing the charts, the time intervals involved in the changes must be readable if accurate total flows are to be obtained either by the observation method or by mechanical integrating devices, such as planimeters or the McGay integrator. Integrating devices that operate directly from the meter mechanism can give accurate totals even though the charts are incapable of accurate interpretation, provided the mechanism that governs the integrator follows the changes in rate of flow.

The amount of fluctuation that can be averaged out by mechanically damping the meter mechanism is much greater than popularly believed, however. For instance, a fluctuation of differential amounting to as much as 60 per cent of the operating differential can be averaged out with an error of less than 2 per cent.

As an example, if the differential is changing on a uniform cycle from "70 to 130", the average differential, "100", represents the actual flow within approximately 1.2 per cent. If the flow is changing on a sine curve, the error is much less.

If, however, the actual rate of flow drops to zero, as is often the case when "off and on" control is used for operation of the process or equipment using the gas, or when an extremely narrow throttling range pressure regulator with friction in the mechanism is used, the error introduced by averaging may exceed 40 per cent. In such cases the readings of the meter cannot be taken as an indication of the actual change in rate of flow, because any recording meter must have a certain amount of inherent damping in order to give readable flow records.

Fig. 1. is a chart of a dual flow meter showing what happens when off-on control action is introduced. High speed chart drive was used. The record shows the effect of inherent damping.

Contrary to general belief, the use of mechanical damping in the meter body does not increase this error. The error is present whether the differentials are averaged by observation or by throttling of the meter mechanism.

Mechanical means of damping are to be preferred, because this method automatically takes into consideration the duration of the high and low periods of flow. Quite often an unbalanced wave form (that is, one in which the period of time at the low flow is much greater than that at the high flow or vice versa) appears merely as a broad line on the chart record, and the chart reader, whether operating by the observation method or using an automatic chart integrating device is faced with a pure guess as to the proper point in the wide line to use as an average.

● **Eliminating or reducing fluctuations.** There are several possible remedies for this situation. The first and most obvious remedy is the substitution of a full throttling automatic control mechanism for "on-off" control. This is not always practical. For instance, in glass furnace operation, a reversal of the flow through the furnace is required for economical operation and the shut-off period on the fuel is required for safe operation.

If the durations of the zero periods are known, reasonably accurate results may be obtained by averaging the top of the record and multiplying the computed flow by the ratio of the actual time gas was flowing to the total time. This method has been used with surprising accuracy in the measurement of molten sulphur in sulphur mining operations.

Another method lies in the use of cushioning capacity between the meter and the point of consumption. The efficiency of this capacity in producing a cushioning effect is increased by the use of throttling means (a throttling orifice, pinched valve, or pressure controller with wide throttling range) immediately down stream from the orifice meter.

A narrow throttling range pressure controller or regulator at this point prevents the pipe between meter and point of consumption from acting as a surge chamber. If close pressure control is required for proper functioning of burners or other equipment using the gas, it should be installed as far from the outlet of the meter as possible.

Another possible solution is the use of an extremely fast meter equipped with automatic integrator. In this case the chart is of no value as a means of checking total flow, but is recommended to provide proof that the meter is always operating within its range.

● **Problem 2, Readability of meters on widely varying flows.** Another limitation of the differential type meter is its readability. A common error in thinking is to assume that because a meter reads zero at zero flow and perhaps 10,000 cu ft per hr at maximum flow its rangeability is zero to 10,000 cu ft per hr. The error in this line of reasoning is obvious if a quick computation of the reading of the meter at 100 cu ft per hr is made. As this flow is 1/100 of the maximum, the differential would be 1/10,000 of the maximum, and the recording pen would not move perceptibly off the zero circle.

The square root relationship between flow and differential greatly narrows the usable range of flow readings.

Assume that the average operator can read a fluctuating differential record at best to within ±1/100 of an inch, and interpreting this in terms of per cent of full chart scale, the possible error would be ¼ of 1 per cent of full scale differential. At 5 per cent of full scale differential this would be 5 per cent of actual differential, or approximately 2½ per cent of flow. Assuming this to be the minimum usable differential, the flow rangeability of the meter calculates to be slightly less than 4½:1.

*Presented before the Fuels Division of The American Society of Mechanical Engineers, New Orleans, Louisiana, March 1-4, 1948, under the title "Accurate Wide Range Metering of Natural Gas With the Differential Type Meter."

†The Foxboro Company.

FIG. 1

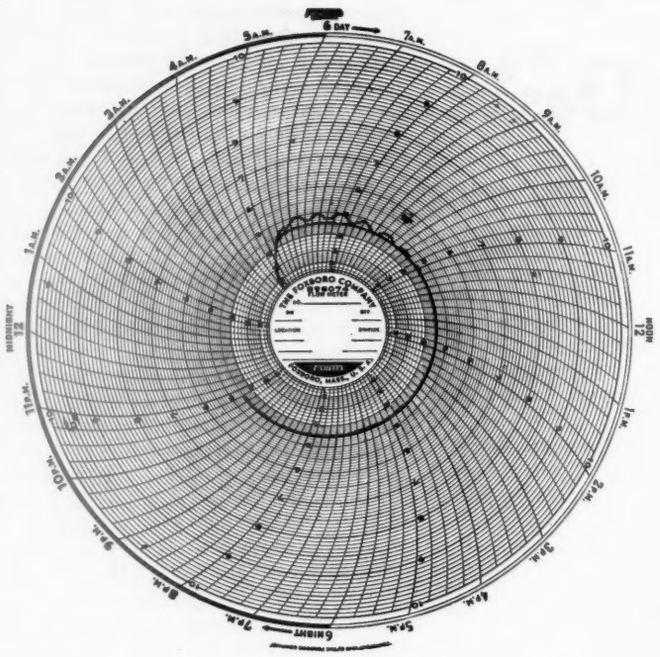


FIG. 2

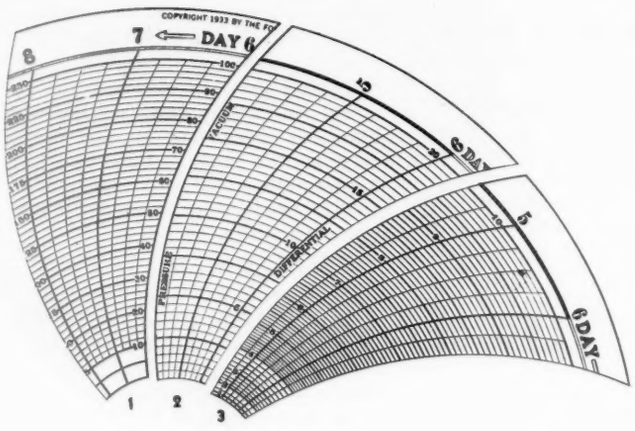


FIG. 3

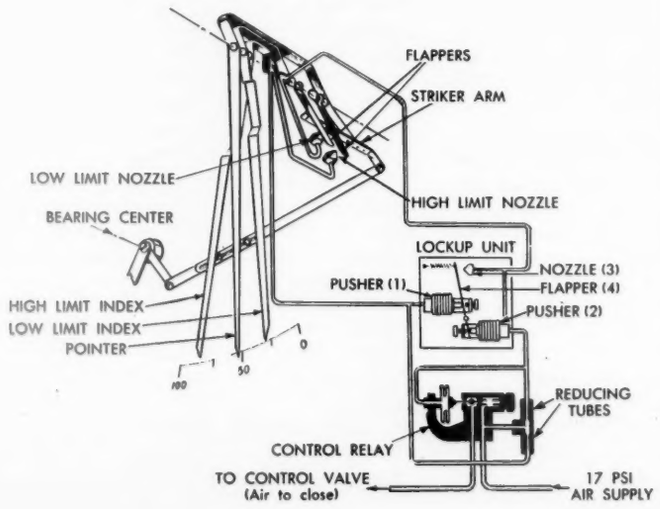


FIG. 4

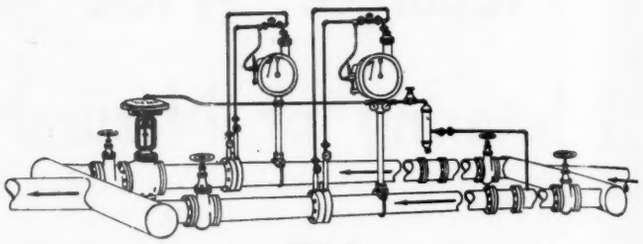


FIG. 5

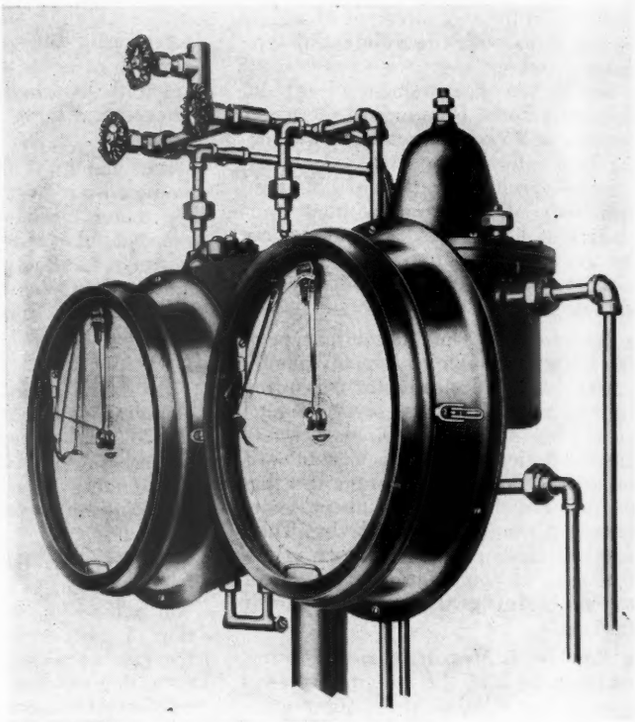
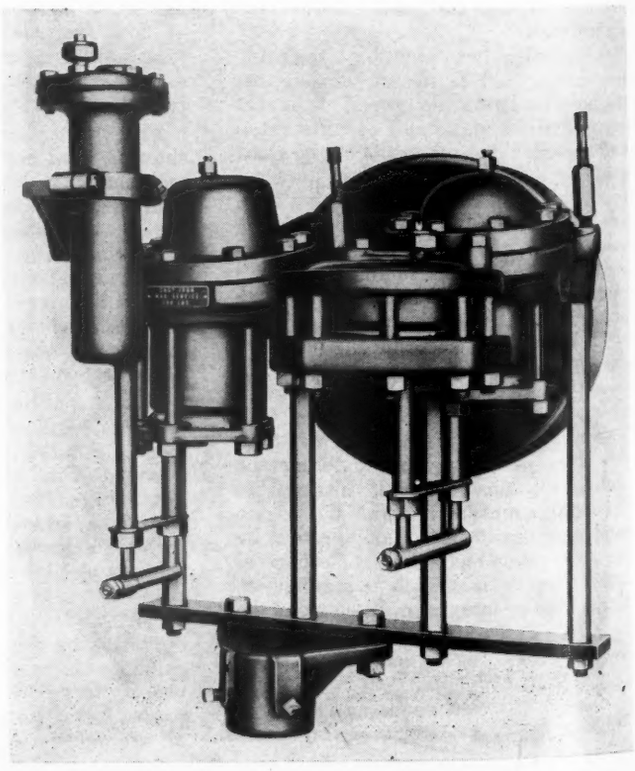
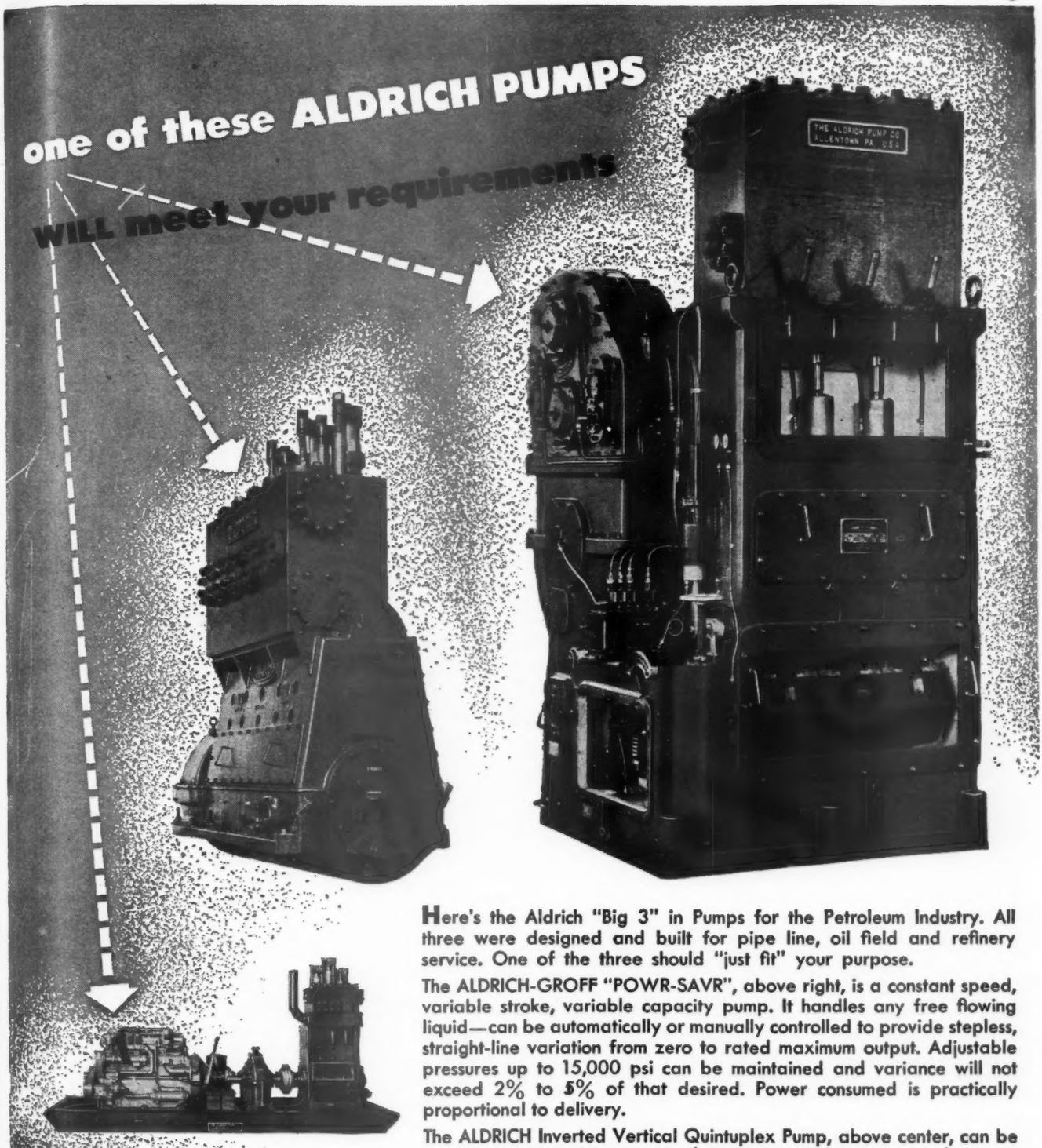


FIG. 6





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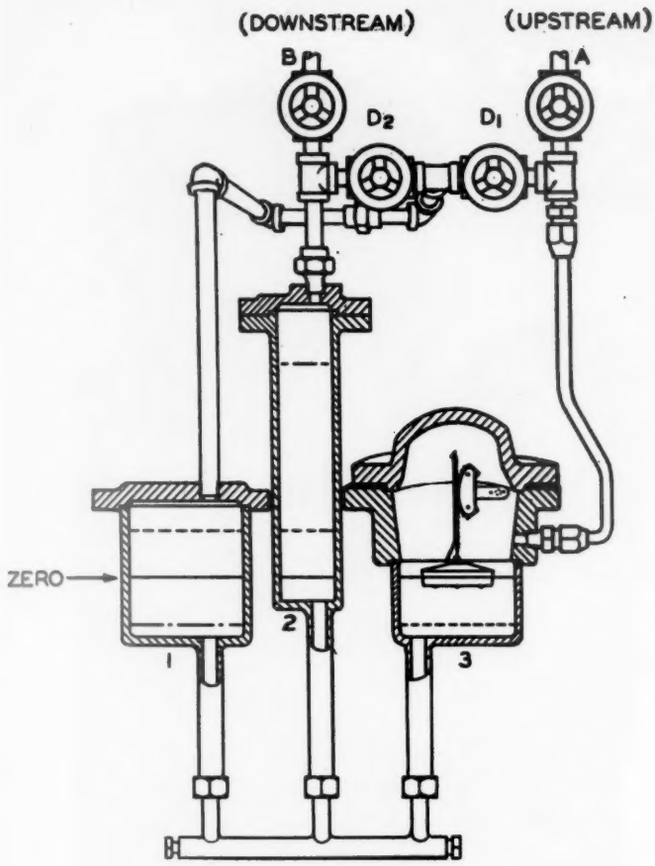


FIG. 7

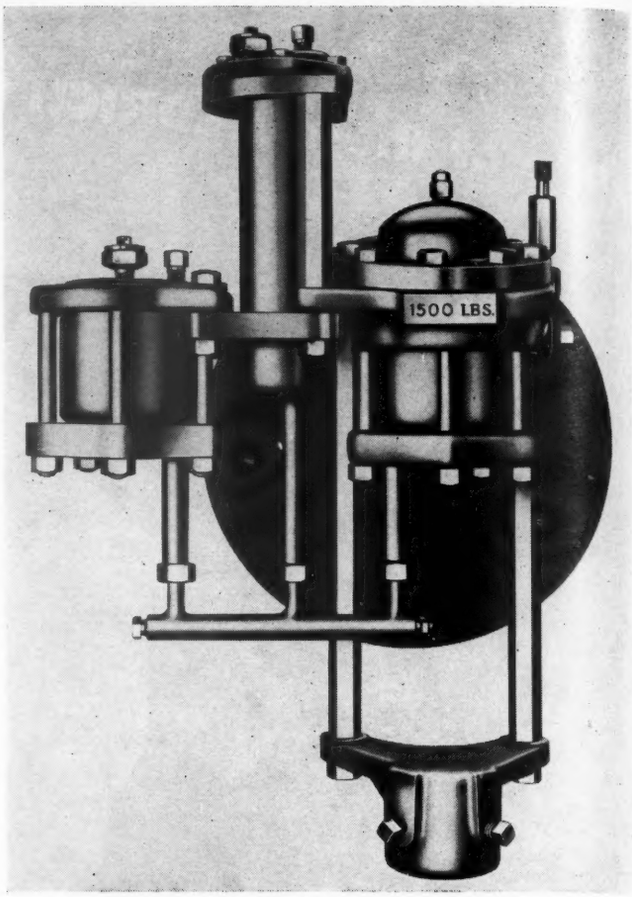


FIG. 8

It may be argued that with a meter equipped with automatic integrator, the accuracy is not dependent upon the readability of the chart. The rebuttal to this argument lies in the fact that the differential mechanism must be calibrated against some standard at the factory and must be rechecked time and again after it is placed in operation. It is axiomatic that it would be impossible to calibrate consistently closer than the instrument could be read.

● **Methods of increasing readability.** The uniform flow scale meter provides a partial answer to this problem. By mechanical means, the spacing at the lower readings of the chart are spread out and the readings at the outside of the chart narrowed down proportionately. This increases the readable range of flows to approximately 10:1.

Fig. 2 shows: (1) Uniform flow scale chart; (2) Differential scale chart for square root flow scale meter, and (3) Square root flow scale chart for square root flow scale meter.

This solution has practical drawbacks that make it a questionable solution of the problem. The mechanism is inherently more complicated and more difficult to maintain in calibration than that of the simple meter that records differential on a linear chart. Other methods have proved more popular in the measurement of natural gas.

Probably the simplest and most obvious method of adapting the standard differential type flow meter to wide ranges of flow is the use of multiple meter runs. The first meter run is equipped with an orifice small enough so the minimum flow readings will not be recorded in the lower and congested part of the flow chart. When the flow capacity of the first meter is reached, a second meter is cut in. This secondary meter is such that the readings of the two meters operating in parallel will drop back to the minimum usable portion of the chart. This increases the flow rangeability by a geometric proportion, and additional meter runs could be added to obtain any desired flow rangeability.

Unless this system is made automatic, peak flows on sudden and unpredictable load changes may be lost during the interval before the changeover is completed.

To make this switchover automatic, the differential relief valve was developed. The early models were a modification of the differential regulator principle but equipped with a long arm with a rolling weight that was presumed to roll from one end of the lever to the other to give a dead space in the control mechanism. Slow changes in differential were found to permit this rolling weight to get in the dead center position and oscillate giving cycling control which made records completely unusable. Sudden changes in differential have been known to hurl the weights of the arm with such violence as to cause danger to nearby personnel.

The need for a more positive, more predictable, and easier to adjust mechanism was met by the automatic differential limit controller, which closes the valve by pneumatic pressure and opens it by the force of a spring. The high and low differential limits may be set precisely on this type of device to obtain the maximum rangeability from the minimum number of meter runs.

Fig. 3 shows a pneumatic lockup mechanism of differential limit controller.

When more than two meter runs are used, the need of proper cascading action of the limit controllers makes it almost essential that the set points be predeterminable with extreme accuracy.

Fig. 4 shows a multiple meter run installation using differential limit controller for automatic operation.

One of the disadvantages of the multiple meter run system is the number of charts that must be computed. It would seem desirable and perfectly within the realms of possibility to develop a controller that would shut off the first meter run as the second and larger meter went into operation and would put it back into operation and cut out the larger meter run when the flow dropped below the readable portion of the chart of the larger meter.

Flow rangeability may be gained by the use of two differential gauges of different ranges both operating from the same orifice. Common range combinations are: 20 in. of water and 100 in. or 10 in. and 50 in. The high flow readings are read from the high range chart, and when the differentials drop to values that record on the low range gauge, the flow readings are taken from this chart.

Fig. 5 shows two meters of different ranges in wide range meter setting.

This combination has been consolidated in a single instrument. Usually this instrument has three pens: One recording static pressure, one recording the high range differential, and the other recording the low range differential. This design simplifies the problem of filing charts and eliminates difficulties of synchronization of clocks.

Fig. 6 shows a dual meter—20 in. and 100 in. on the same case.

For locations where weekend loads, holidays, etc., make the periods of low flow predictable, a meter with a single differential pen, the range of which may be changed by manipulation of valves, may be used. When using this type of meter, the range combination of 25 in. and 100 in. is convenient because it results in a flow-range ratio of 2:1.

Fig. 7 shows a diagram of the chamber construction of a two range meter.

Fig. 8 shows a duo-range meter body.

A system of measurement that should be mentioned in any discussion of means of measuring wide ranges of flow is the adjustable orifice plate. This is in reality a highly refined modification of the gate valve principle. It is equipped with a vernier scale that permits determining the area of the opening to extremely close limits. The coefficient of this flow restriction is read for any position of the stem from a blueprint curve plotted from hydraulic test data.

The recording and/or integrating instrument used with the adjustable orifice may be equipped with a control mechanism similar to that of the differential limit controller to reposition automatically the adjustable orifice in predetermined steps to keep the instrument readings within the range of operation of the integrator and/or in the readable portion of the chart. The same control mechanism changes the speed of operation of the integrating mechanism.

● **Conclusion.** Although the differential type flow meter has many handicaps as the means of determining total flow, popularity of this type of meter is adequate proof that the advantages more than counterbalance the disadvantages. The simplicity, accuracy, freedom from wear, ease of checking, low cost, flexibility of flow range, and other desirable features make it first choice of metering equipment whenever its limitations can be overcome. There is much more work to be accomplished, but we believe manufacturers of the differential type flow meter can be proud of the progress so far.

★ ★ ★

Barge for sulphuric acid transportation

A new barge specifically designed for transportation of sulphuric acid on the Intracoastal Waterway has been launched at the Neville Island Shipyard of Dravo Corporation, Pittsburgh, Pennsylvania.

The 175-ft vessel, named the *Gloria*, was built for Consolidated Chemical Industries, Inc., Houston, Texas. It will enable an increase in marine deliveries of sulphuric acid to plants in the chemical and oil industries along the waterway route covering Texas, Louisiana, Mississippi, Alabama, and Florida.

Design of the welded steel barge is based on a study of the various problems in carrying sulphuric acid on inland waterways. Although acids of various kinds now are transported by barge, many of the vessels used are ordinary hopper barges converted by installation of tanks. The design of the *Gloria* was developed especially to suit the particular service requirements of Consolidated Chemical Industries, Inc.

In the new barge, concentrated sulphuric acid will be carried in two cylindrical steel tanks running parallel the length of the hold. Each tank is 8½ ft in diam and 135 ft long. Their combined capacity is about 865 short tons of acid. The tanks are strapped in cradles formed of 2-in. thick treated hardwood blocks on steel supports. The tanks are sealed under pressure during voyages.

When diluted with water, concentrated sulphuric acid becomes extremely corrosive and, for this reason, the barge was decked over with steel to make the hold watertight. Entrance to the hold is through two watertight hatches, one at each end of the deck.

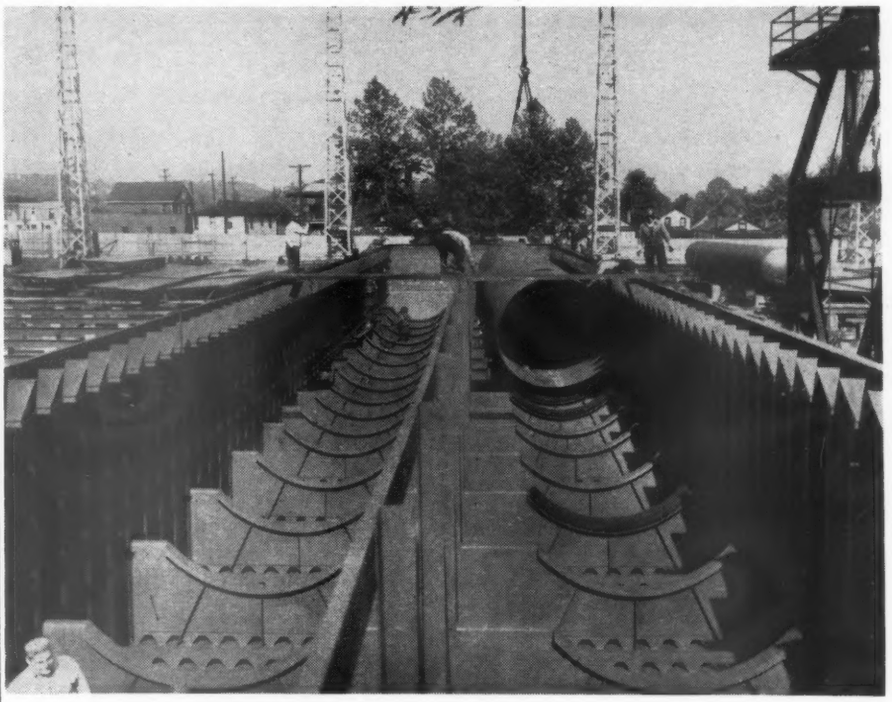
Two special pumps, manufactured by the Charles D. Lewis Company, St. Louis, Missouri, are installed on the barge deck in midbody for discharging the acid.

The barge is 30 ft wide and 10 ft, 8 in. deep. Side decks were designed 3½ ft wide to provide ample space for crews handling mooring lines and cargo loading and discharging lines.

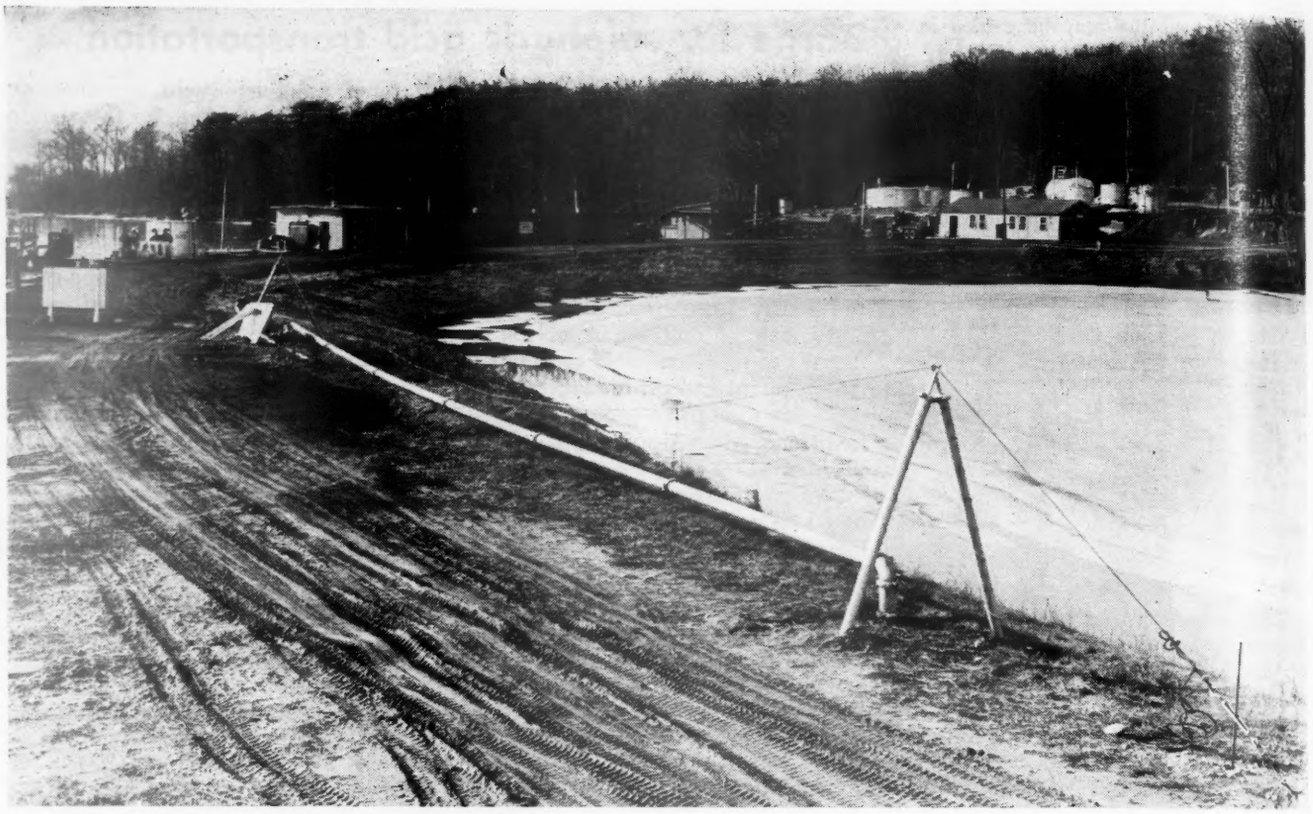
Hull of the barge is shaped for minimum towing resistance and has well-rounded corners to minimize damage to other craft or wharves in the event of a collision.

The "lighters" or barges that these men captained are about 127 ft long and 34 ft wide, with a deck cargo space of about 100 ft by 32 ft. They are used for the transportation, in tow, of drums, cartons, cases and other containers for petroleum products.

A "lighterman" or barge captain is usually the entire crew and his work consists of loading and unloading these containers — frequently 55-gal drums weighing 500 lb—over the sides of the vessels; placing them so that the cargoes will be seaworthy and in such a manner as to insure speedy and efficient deliveries to ships, piers, warehouses, and refineries. ★ ★ ★



Installing acid tanks in new barge at Dravo shipyard.



Pipes, pumps, filters, storage tanks, gaskets, methods, adaptations, and techniques get a going over at the Petroleum Distribution Test Area of the Engineer Research and Development Laboratories, Fort Belvoir, Virginia, before they are adopted as standard by the Corps of Engineers.

Trends in Military Pipe Lines

KENNETH L. TREIBER*

GASOLINE is the life blood of a modern army. When Hitler's much-vaunted and highly mechanized blitz army ground to a virtual standstill in 1945, it was largely due to petroleum starvation—thanks to a series of blows delivered to the rich Balkan oil fields by the 15th Air Force. And "Blood and Guts" Patton, famous commander of the U. S. Third Army, once said that at times gasoline was more important to his outfit than food.

Five million gallons of gasoline a day is enough fuel to have operated every motorized vehicle in the world in 1941 on a run from New York to Chicago. Yet that is the average of the 1,645,145,840 gal of oil and gasoline delivered to depots and air bases on the continent of Europe between D-Day and VE-Day.

This feat was accomplished by three major pipe line systems, which pumped fuel through French and Belgium ports to United States Armies. The major system, extending from Cherbourg to Mainz, had a daily capacity of 1,700,000 gal. A northern system from Antwerp to Wesel supplied 1,300,000 gal daily. The southern system, extending from Marseilles to Worms, had a daily capacity of 700,000 gal. These systems, constructed and operated by 20 petroleum distribution companies comprising 4400 officers and men, constituted a great saving in manpower and equipment over the outmoded method of motor and rail transport in bulk or drums.

There was probably no more graphic account of the role played in the supply of fuel to the United States and our allied forces in Asia than that of Representative Mansfield (Texas) in his eye-witness account of the Ledo pipe line in the CBI Theater. This pipe line consisted of two 4-in. lines consisting of 750,000 sections of 20-ft pipe. It had a carrying capacity equivalent to that of 400 cargo trucks and had the added advantage of not overtaxing the already crowded truck routes in the CBI Theater.

*Chief, Petroleum Distribution Branch, Engineer Research and Development Laboratories.

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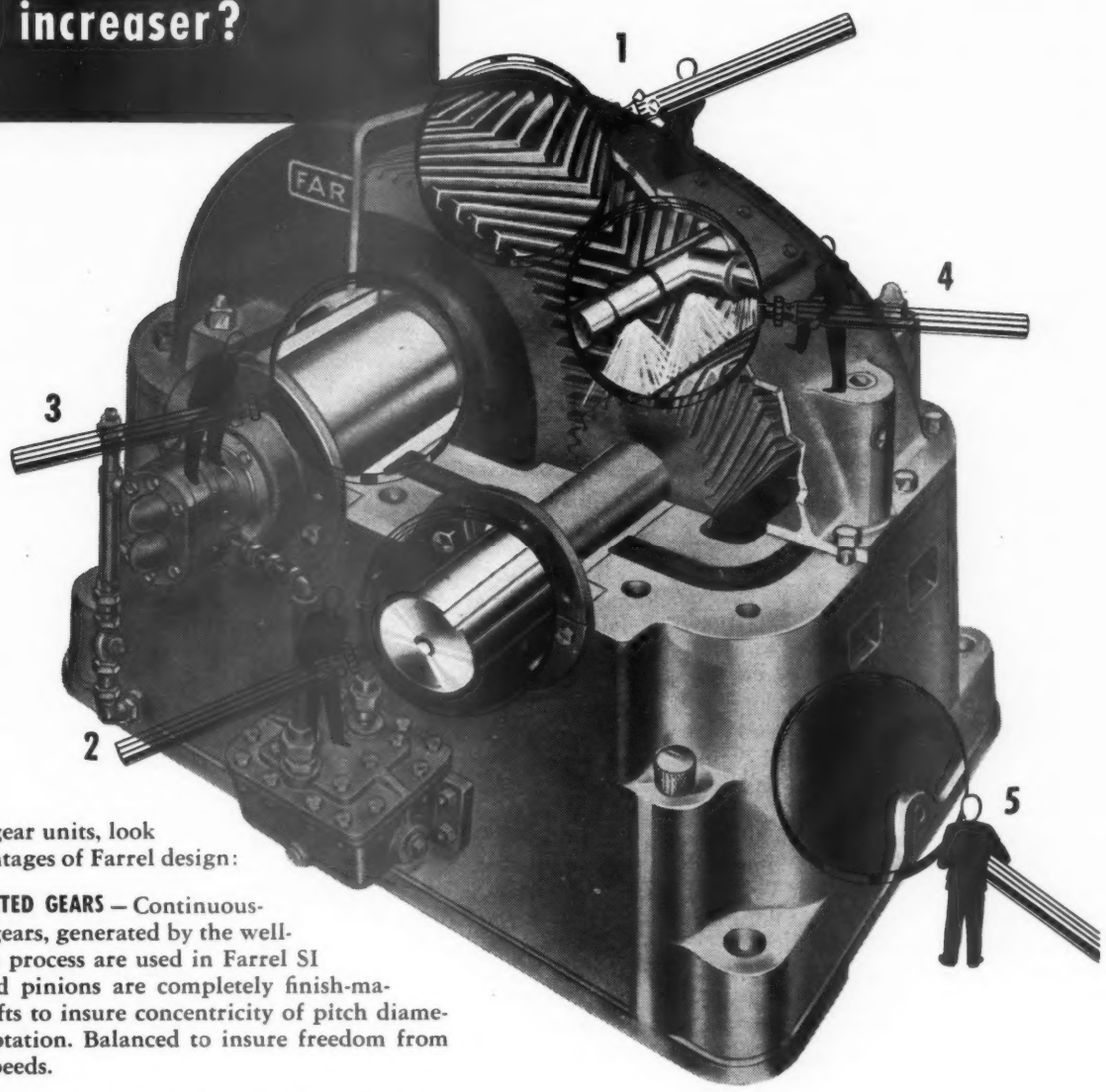

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5. HEAVY, RIGID HOUSING — This housing is an exceptionally rigid structure to insure the operating smoothness of the precision-generated gearing.

Farrel speed increasing units are available in 49 standard sizes with speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1.

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After a three-day inspection tour over the Ledo road itself, Representative Mansfield said, "Behind the building of the pipe line lies an engineering achievement unsurpassed anywhere. In a 24-hr period they will deliver approximately 8000 bbl of fuel, or 336,000 U. S. gal." Furthermore, during the time of his inspection, he said that the line was supplying the necessary motor gasoline, high-speed diesel, and aviation gasoline at all the dispensing points between Ledo and Myitkyina and beyond. This made possible the operation of all the tanks, road graders, bulldozers, cargo trucks, jeeps, and cargo and combat planes in the outlying districts.

Mansfield's report outlined the complete background of the pipe line construction, which dated back to the fall of 1943. He described the continuous system from a tanker unloading terminal at Calcutta, following the Brahmaputra Valley through Bengal and Assam, across the Patkai Range into northern Burma, and on into China with the eastern terminus at Kunming in Yunnan Province.

"The line paralleled the Ledo Road from Assam to its junction with the Burma Road, then it followed the latter into Kunming," he wrote.

"The line was divided into two sections; one section was a 6-in. line from Calcutta to Tinsukia, in northern Assam, approximately 750 miles, where it emptied into a large storage terminal. The other section consisted of two 4-in. lines starting at Tinsukia and ending at Kunming, approximately 1000 miles."

Representative Mansfield continued in his report describing the difficulties encountered in laying the pipe line, such as stream crossings and the transport of pumping stations and pipe into almost inaccessible regions. But this is only one story in the great epic of supplying fuel to our far-flung fighting fronts. Every small island seized in the Pacific, every liberated country in Europe or North Africa, and every air field in China, Burma, or India, presented its own problem of petroleum supply. It was indeed fortunate that this demand was speedily fulfilled; otherwise, the war might have been seriously prolonged.

No small part of the success of the rapid supply of petroleum equipment to our overseas armies can be accredited to the Corps of Engineers, principally the Office, Chief of Engineers, and personnel of the Engineer Research and Development Laboratories, the Corps of Engineers' research organization at Fort Belvoir, Virginia. It was the latter that was assigned the mission of testing and improving upon commercially available equipment and designed new types for the use of engineer troops. Furthermore, the Engineer Research and Development Laboratories assembled for publication the necessary information on installation and operation of pipe line and storage equipment necessary to handle the vast quantities of petroleum products that would be sent to our forces throughout the allied world.

It wasn't until the early part of 1942 that a small group of military and civilian engineers sold the idea of a military pipe line to the Army. At first the concept was received with skepticism, but was finally adopted, and pipe line and pumping equipment were purchased on a grand scale for all theaters of operation. The Army Portable Pipe Line got its start with the handful of men called upon to develop and test equipment, to write a pipe line manual, and to organize and then teach in the pipe line schools.

The early pipe line equipment was improvised; it was simply a case of using what was available to do the job. The first pipe was lightweight tubing with standard weight nipples welded on the ends to provide the necessary metal so that an angular groove could be turned to receive the lock for the standard groove type flexible coupling. Comparative tests were not conducted on available pipe to determine its ability to withstand military usage. The pipe was merely subjected to hydrostatic tests and shipped for overseas use. As a result, inferior pipe incapable of withstanding the crushing effect of unloading from flat cars, trucks, and dock facilities was obtained, and a good percentage was damaged to the extent of making it useless. In addition, the gaskets used in connection with the pipe couplings lost resiliency due to the alternate wetting and drying with gasoline during intermittent service. This resulted in frequent leaks.

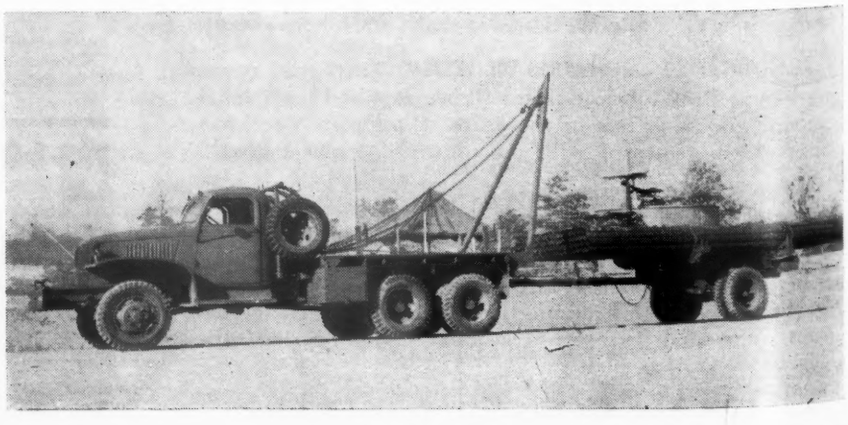
Early pumping equipment tested by ERDL did not prove much better because it was difficult to control; however, since it was the best obtainable, it was procured and petroleum distribution companies were trained in its operation.

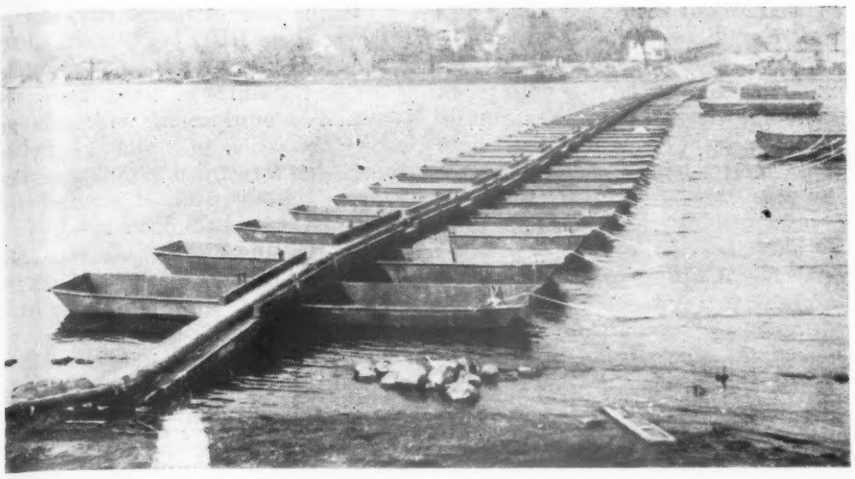
Meanwhile, tests of petroleum handling equipment continued at the Fort Belvoir petroleum handling test area. Wartime shortages made necessary the substitution of inferior equipment and material. One overseas officer wrote a letter stating that the pipe line valves they were receiving must have been made of clay and that there was dire need of good steel valves in a hurry. This comment was brought about by the fact that valves were being fabricated from cast iron, for steel valves were going to the shipbuilding industry. Another great weakness of the pipe line equipment was the inability of the Army to standardize on such short notice. For example, many bolted storage tanks were not erected because different crates contained tank sections of various

LST's Converted

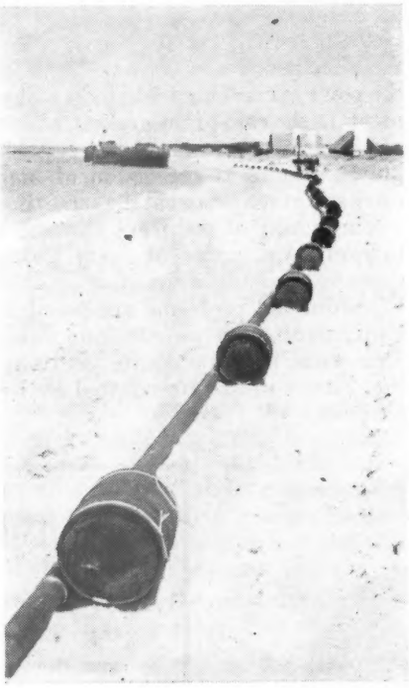
Work has started at the Waterman Repair Division of the Waterman Steamship Corporation, and the Gulf Shipbuilding Corporation yards in Mobile, Alabama, on the conversion of three war built LST's. Conversions will provide employment for approximately 1200 workers for a period of two to three months. Officials of both firms stated that the vessels will be converted and used by the Humble Oil and Refining Company as off-shore oil drilling barges in the Gulf of Mexico.

The Army pipe line truck with a two-wheeled pole type trailer is one of the more conservative methods of transportation devised by the Engineers for military petroleum pipe line construction. The Engineer Research and Development Laboratories have found helicopter deliveries to be feasible.





Across mountains and rivers, plains and deserts, wherever the Army went, Engineer pipe line construction troops soon followed to supply the ever-increasing demand for petroleum products in a swift, mechanized war.



At Martha's Vineyard Island, the Army Engineers tackled the problem of undersea pipe lines to transport gasoline and oil across the Channel from England to France. Pictured here is such a line being prepared for submerging.

manufacturers whose parts were not interchangeable.

One difficulty experienced in pumping stations was the inability of pump engines to use aviation fuel. In a line where high octane fuel was flowing in abundance, it was sometimes necessary to transport motor fuel to pumping stations in distant and difficult regions. This was necessary because tests indicated that the exhaust valve life of automotive engines designed to use 72-octane gasoline did not exceed 160 hr continuous operation when aviation fuel was used. The use of a simple release mechanism (roto valves) and austinetic steel and stellite faces made possible the extension of the exhaust valve life to 2400 hr. When tests were terminated, the valves showed little deterioration, and it appeared they would be good for another 2400 hr.

During the early days of the Army Portable Pipe Line, the need arose for suitable carrying and installation equipment. Fortunately the bed of a standard Army 6x6 truck was sufficiently long to accommodate the pipe lengths and pumping station equipment. Therefore a standard conversion kit was developed for installation with the Army 6x6 truck. This included the necessary equipment for mounting the winch in the rear of the cab, the installation of a headache post, and the necessary equipment for attaching a roller for mounting equipment on the rear of the truck bed. Other developments along this line were the conversion of the ¼-ton 4x4 truck to carry eight 20-ft lengths of 4-in. pipe, and the adoption of the Corps of Engineers Ponton Trailer to carry pipe line equipment. The conversion of the ¼-ton truck proved valuable in the CBI Theater where narrow roads and mountain trails were the best routes of transportation available.

Because of the lessons learned in the CBI Theater where sometimes 90 per cent of pipe line construction time was spent in building road communications, ATC members thought it might be practical to use helicopters in the transport of pipe line equipment. The Engineer Research and Development Laboratories managed to obtain an experimental XR5 helicopter to use in conducting tests. A suitable carrying adapter, capable of securely fastening all types of pipe line loads, was designed and fabricated at Engineer Research and Development Laboratories. Using experienced pipe line troops, preliminary tests were conducted at Camp Claiborne, Louisiana, where the actual loads were fastened to the carrying adapter, flown a distance of five miles and placed in position along the proposed route. In order to determine the life qualities of the helicopter at various altitudes, the tests were repeated at Garden City, Kansas, and at Denver, Colorado Springs, and Pikes Peak, Colorado. These tests proved the feasibility of such an expedient in transporting pipe line equipment; however, it was believed that such a procedure would prove more practical following the development of cargo helicopters capable of transporting greater loads.

As early as 1943, plans were made to obtain a modern pipe line pumping unit, but because of the priority of other items, this plan did not materialize until 1945 when it resulted in the design and procurement of 4-stage centrifugal pumping units for use on the standard 4-in. pipe line, and 2-stage centrifugal pumps with capacity of 1000 gpm at 440-ft head.

Again in 1943, the Engineer Research and Development Laboratories was called upon to determine the best method of installing sea-loading lines, consisting of hose or pipe lines used to unload tankers into tank farms situated on shore. Tests were conducted at Martha's Vineyard, Massachusetts, on three proposed installation methods before the best method was selected for use in the various theaters of operations.

An additional project was undertaken at Martha's Vineyard Island to determine the feasibility of using 4-in., grade B, extra-strong pipe to convey gasoline from England to France beneath the English Channel. Pipe in five-mile lengths was towed to sea and connected by divers using special adapter links in water 150 ft deep. Special surface connectors also were used. This project was abandoned when it was learned that the Royal Engineers had a similar project under development and the chief of staff had requested that the work being done in England be continued. The use of the lines across the English Channel, in-

stalled by the Royal Engineers, was discontinued following the virtual destruction of the German Luftwaffe.

In the field of aircraft fueling, the Engineer Research and Development Laboratories tested a gasoline refueling loop for airfields using the best equipment and practices available at the time. This system was designed to eliminate the necessary tank-truck refueling that the Air Forces had standardized for overseas installations. At the present time the Air Force is particularly interested in refueling from aprons because of the increased fuel capacity of our long range bombers. An example of this type of system is the one used at Fairfield-Suisun field, Oakland, California. This underground pipe line system features electric control switches that can be operated from any point along the apron.

These are only a few of the details investigated, developed, and tested by the Engineers in attempting to perfect a portable pipe line system. After VJ Day and at the present time, developments have continued to improve upon the systems of fuel supply for our armed forces. Because of increased demands on fuel supply it is believed that 8-in. pipe lines will have to replace the 4-in. and 6-in. lines previously used in order to meet the 1000 gpm demands of our armies. As a 20-ft section of military 8-in. steel tubing equipped with standard weight nipples, for grooved type couplings on each end, weighed more than 300 lb, it was necessary to find a new, light metal material so that pipe lengths could be transported easily by hand.

Investigations were made in 1945 to determine the practicability of using aluminum or magnesium alloy extruded tubing to replace the conventional steel pipe. Investigations indicated that the aluminum or magnesium alloy 8-in. pipe would weigh less than steel 6-in. pipe. Therefore, this pipe was developed and procured. Current Army operations in the Arctic have presented new problems. Where temperatures drop as low as —70 F synthetic rubber pipe line gaskets lose their resiliency and become brittle to the point of cracking with slight movement. In the case of the gaskets, efforts are being made to develop a suitable polymer to resist the action of high aromatic gasoline and at the same time retain quality of resiliency through a temperature range of from 120 F down to temperatures as low as —80 F. Additional problems are posed in equipment such as gasoline-water separators, pipe line valves, and pipe line filters, which are affected by ice particles.

In the case of bolted steel storage tanks, the ERDL is designing 1000 and 10,000-bbl tanks incorporating the best features of all commercially available equipment with ultimate standardization in view. These plans are being forwarded to tank manufacturers for approval. It was believed this plan would eliminate much of the difficulty found in the past war when tank sections frequently were not interchangeable. New designs of steel and alumnium storage tanks are being sought to eliminate the large numbers of bolts now used. Besides study and adaptation of conventional equipment, the ERDL is developing revolutionary ideas in the design of amphibious pipe line trucks, lightweight collapsible gasoline hoseline systems, portable collapsible 10,000-gal gasoline storage cells, lightweight fiberglas plastic pipe, and other equipment for airborne transport.

It is gratifying to note the amount of equipment developed by ERDL that industry has found useful. It is with this added stimulus that the laboratories press forward, confident that whereas they make the defense of this country more secure by developing improved equipment for the armed forces, industry, too, will benefit by this work.

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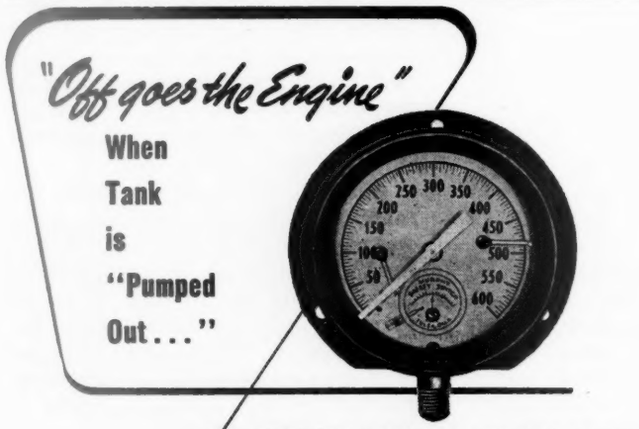

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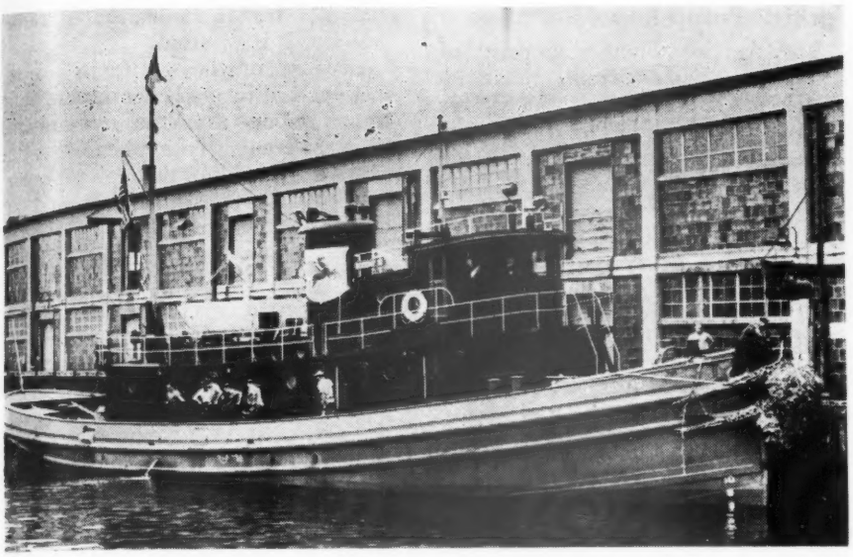


Socony 10 replaces steam engines with diesels.

Modernizing Tug Fleet

FEW people outside the petroleum industry can visualize the extent of the maritime operations of oil companies, or realize that their marine department has many thousands of employes. including land and sea-going engineers, naval architects, electrical machinery experts, and other technicians. Tankers, which represent a substantial part of the American Merchant Marine, are by no means the only type of vessel owned. Some idea as to the cost of keeping American oil tank-ship fleets up to date will be gained from the fact that now building in U. S. yards are 63 sea-going ships valued at more than $320,000,000.

The ramifications of the petroleum business are so extended that a variety of craft are needed for domestic and foreign operations, such as harbor tugs, river towboats and barges, geophysical and exploration cruisers, oil well drilling barges, floating hotels for off-shore drilling crews, derrick barges, pile-driving barges, and—the latest addition—converted LST's, are used in connection with drilling at sea in the Gulf of Mexico. In addition, oil companies contract for extensive ocean towing work.

Recently, the Socony-Vacuum Oil Company's marine transportation department decided to modernize its New York district tug fleet. A new tug, built at Port Arthur, Texas, has been purchased from the General Motors Corporation, and two existing steam tugs are to have their machinery replaced with G.M.-Cleveland Diesel engines of 1000 hp each, which will greatly improve their economy and efficiency. Socony's marine department is under Frederick R. Pratt, with W. B. Jupp as manager.

Socony 10, the new tug, recently made the run from Port Arthur to New York under her own power, averaging about 10½ knots. Shortly after her arrival a demonstration run was made from Bayonne, New Jersey, to Port Socony, Staten Island, New York, for the benefit of a number of newspapermen and editors.

She is typical of the fine steel tugboats turned out at the yard in Port Arthur. The propeller is driven through an airflex coupling and reduction gear, a comparatively simple installation.

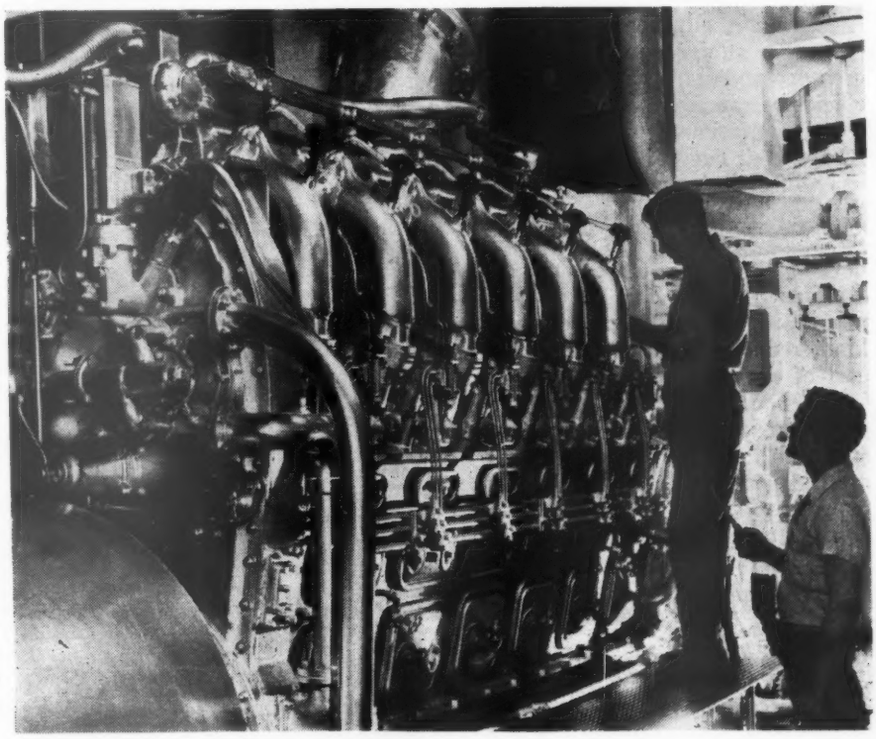
Socony 10 has very pleasing lines. She is 102 ft long, by 24 ft beam, 12 ft 4 in. depth, and 10 ft 6 in. draft. and is classed to the American Bureau of Shipping highest standard of workmanship. Her propelling unit consists of a 12-cylinder V-type G.M.-Cleveland Diesel engine of 1000 bhp, and of the 2-cycle type.

For auxiliary power there are two 30-kw General Motors diesel-generator sets, one small diesel-driven, self-contained, pumping unit, and a large electric storage battery for starting the main engine, and which also provides lighting current when the diesels are not running.

Accommodation is provided for a total of 10 officers and crew. She is equipped with ship-to-shore telephone, and with a radio direction finder.

Work on converting the two Socony steam tugs to Cleveland Diesel power began during January. By mid-summer they should be ready to join their sister in New York Harbor. * * *

New 12-cylinder 1000-hp diesel.



NEWS

Turboflow Compressors Ordered for Gas Line

The Cooper-Bessemer Corporation has been awarded a contract for the construction of 21 new-type "Turboflow" gas engine driven compressors, the largest of their type in the world, for the Transcontinental Pipe Line Corporation's proposed 30-in. pipe line, which is to be built by Fish Constructors, Inc., Houston, Texas. This contract is announced by Gordon Lefebvre, president and general manager of Cooper-Bessemer, a principal builder of large gas, diesel, and gas-diesel engines.

The contract represents authorization to build 70 per cent of the gas engine driven equipment required for Transcontinental's 1949 construction program, according to Lefebvre, who states that fuel economies in the operation of these engines are made possible by "Turboflow" (a recent Cooper-Bessemer development).

The 10-cylinder GMW gas engines scheduled for this project are rated at 2400 bhp each. As a result of the Turboflow development, these engines will draw 15 per cent less fuel from the line than formerly needed to operate conventional gas engines of equal horsepower, says Lefebvre.

"It is conservatively estimated that well over 5,000,000 cu ft of natural gas will be saved each day through the higher operating efficiencies of the new-type Turboflow engines," Lefebvre went on to explain.

"This big advance in engine efficiency is attained primarily by incorporating improved combustion efficiencies in gas engines, obtained by a more intimate mixture of the gas fuel with air and unique developments in ignition design.

"In addition to 15 per cent lower fuel consumption, Turboflow engines develop 10 per cent more horsepower. This means simply that fewer engines will be required on a project of this kind, reducing both the number and cost of engine foundations necessary in the booster stations. In turn, this greatly reduces the overall cost of installation, piping, housing, and operating personnel. Less maintenance expense will be a further cost saving benefit to Transcontinental in the actual operation of the pipe line."

The Transcontinental Pipe Line will deliver 500,000,000 cu ft of natural gas each day from reserve fields in the Gulf-Texas areas over a distance of 1840 miles to the terminus on the east bank of Hudson River, New York.

Aldrich Pump Representative

The Aldrich Pump Company of Allentown, Pennsylvania, manufacturers of reciprocating pumps for medium and high pressure services, announces the appointment of the Jesse W. Eakins Company as their new representative for the Detroit area. The Jesse W. Eakins Company is at 3105 East Grand Boulevard, Detroit 2, Michigan; their appointment became effective as of January 1.

Oil Sample Located in Pipe Lines by Radioactive Barium

A method of telling from outside the pipe exactly where a given sample of oil is located in a pipe line is made possible by the use of radioactive barium, it is announced jointly by California Research Corporation, a subsidiary of the Standard Oil Company of California, and the Isotopes Division of the Atomic Energy Commission. Location of the sample is by detection with a Geiger counter of as little as one billionth of an ounce of radioactive barium added to the oil before it is pumped into the line. Many miles downstream the position of the oil "tagged" by means of the barium isotope can be determined with unerring accuracy merely by holding a Geiger counter near the pipe and watching a meter or listening to the "counts" for an indication of radioactivity, it is asserted.

Because of the simplicity of the method, California Research Corporation predicts that the development "will be generally applicable to the tracing of fluid flow through pipes and to the study of the fundamental behavior of flowing fluids."

To Move Offices

The division office of Lone Star Gas Company now at Denison, Texas, will be moved to Greenville this summer, it is announced. Denison, on the other hand, will acquire the pipe line departmental headquarters. L. M. Tibbals, and three others will move to Greenville; E. K. Smith and ten employes to Denison.

L. F. Dishman to Manage California Coating Plant

Appointment of Leland F. Dishman as manager of the coating and reconditioning division of Pacific Pipeline and Engineers, Ltd., has been announced by Barney Laulhere, vice president and manager of this pipe line construction and engineering firm. The extensive plant placed under Dishman's management is at 1632 South Greenwood Avenue, Montebello, California.

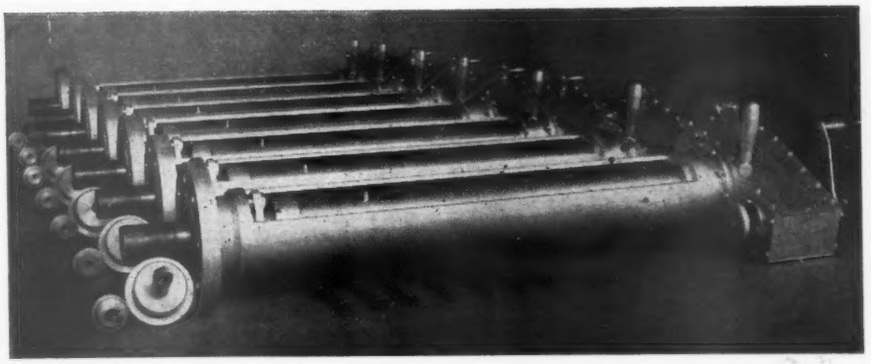
Dishman began learning about pipe lines while working for his engineer-

Gov. Frederick G. Payne of Maine turning the valve at Socony-Vacuum Oil Company's plant in South Portland, opening the 127-mile pipe line to Bangor. The 6-in. line, which carries heating oil, kerosine and gasoline, is the state's first products pipe line and makes year-round distribution of petroleum products possible even when Maine's rivers are frozen over. On speaker's platform as Governor turns the valve are, George D. McDaniel, manager, Socony-Vacuum's eastern region; R. R. Potts, New England division manager; Howard M. Park, in charge of the company's real estate department; A. E. Willis, manager of Portland district; Robert L. Getchell, chairman of Portland City Council; the Governor; George H. Meloon, member of the Governor's Council; Philip G. Willard, chairman of South Portland City Council; Roy Hussey, member of the Governor's Council, and W. H. O'Brien, member, Portland City Council.

World premier installation of a new plastic coated pipe now being introduced by Pacific Pipeline and Engineers, Ltd., is here under inspection by Ben Laulhere, manager of Engineering Services for the Southern California Gas Company, Leland Dishman who has just been appointed manager of the coating and reconditioning division of Pacific Pipeline and Engineers, Ltd., and Barney Laulhere manager of the latetr firm. The installation was a 4-in. line in Bellflower for the Southern California Gas Company who have also made a second installation in the Imperial Valley.

ing degree at University of Southern California where he graduated in 1925. As a chainman in surveying for substructures he worked for George W. Dickenson and Son in Los Angeles developments. After graduation he became construction engineer for E. P. Watson in San Diego returning to the Dickenson company in 1926 as project engineer. In 1927 he became location engineer for the All American Canal with the Imperial Irrigation District and later that same year he was appointed an engineer with the Southern California Gas Company.

In 11 years with the gas company Dishman progressed through positions of growing importance to office engineer to the executive vice president. This employment was broken by four years as an officer in the Air Corps and Ordnance Department of the U. S. Army, which he entered as a captain and left as a lieutenant colonel. His present position with Pacific Pipeline and Engineers, Ltd., is in direct line with his wide experience in pipe line and substructural installations.



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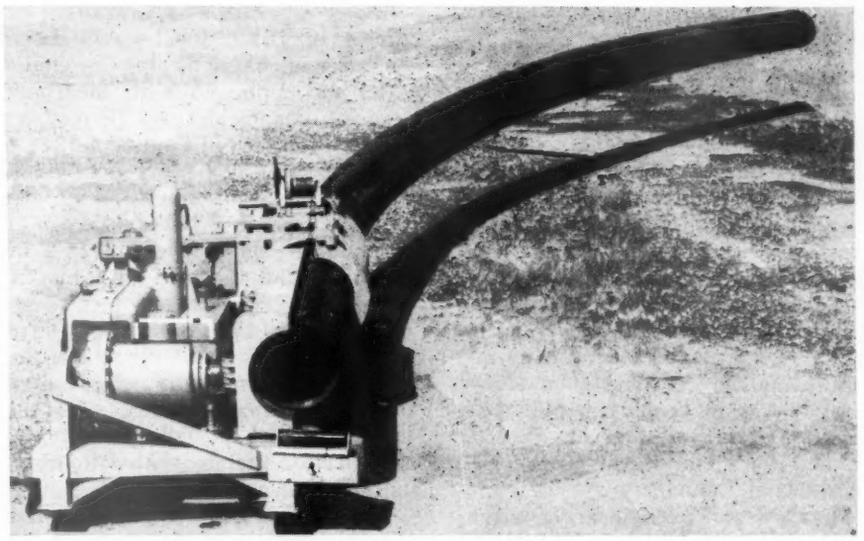

THE COODY "CINCH" BENDER

A length of 26" O.D. pipe 79' long, bent to 47° as shown in the Cinch Bender. This pipe was moved through the machine with a winch powered by a hydraulic motor at the rate of 2 feet per minute, each foot of pipe being uniformly bent to .675°.

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Pipe Line Marine Transportation Personals

J. L. Cahill

J. L. CAHILL, a newcomer to Continental Pipe Line Company as chief engineer, is no new arrival in the engineering field, which has been his realm for 20 years.

Joe, as he is better known out in the "oil patch" where he has a host of friends, is originally a Down-Easter, born in the textile town of Fall River, in the Cape Cod country of Massachusetts. A slight variance by a few miles, to the north or to the east, would have made him a Bostonian or a native of Plymouth, either of which could be called an illustrious beginning.

But Joe is satisfied with his having "landed" at Fall River and if any of his forbears came over on the Mayflower he doesn't hold it against them.

Neither sailing ships nor the hum of a textile mill caught his fancy and he broke New England tradition by going "away" to get his higher education. It was in keeping with family tradition, however, that he went to St. Dunston's University, Prince Edward Island, Canada.

His BS degree in engineering tucked away, Joe didn't return to Fall River, nor nearby Boston, to launch his career. It was in 1929 and he picked the spot where the great financial debacle was centered. He went to work for J. and L. Machinery and Engineering Company, of New York, a firm of consulting engineers specializing in the design of special purpose machinery and precision instruments. It was with this organization that he was first "exposed" to pipelining when he was placed in charge of developing control instruments to be used on a short New England pipe line. Later development work involving pumping and piping problems intensified his interest in hydraulics.

With the coming of war in 1941, Joe shifted his affiliation to Uncle Sam's Navy, where he was associated with the Bureau of Yards and Docks, helping to develop the Seabee program. He worked in turn with the Bureau of Ships and the Bureau of Ordnance.

His work to this time was related in many ways to civilian pipe line operations and many of the war-born developments have proved adaptable to his present work.

In 1945 he went to the Stanolind Oil and Gas Company research laboratory at Tulsa as mechanical research engineer, assisting in the development of new tools and methods for producing and delivering oil to the refineries. This pure research job also provided more ideas for the increasingly important task of applying technical knowledge to the science of pipelining.

After a period as a consulting engineer in Tulsa, Joe became design engineer in charge of pipe line engine sales and applications for the Diesel Power Company at Tulsa. He resigned the position to join Continental.

Joe doesn't boast any hobbies... but maybe it's pipelining, which also is his job. Not a bulky package in make-up, he nevertheless packs a lot of drive, and together with his engineering skill, carries a faculty for organizing and for leadership.

Evidence of these characteristics was expressed recently when fellow pipeliners named him president of the Pipeliners Club of Tulsa, a regional organization that he shared in forming.

Joe and Mrs. Cahill, the former Miss Virginia McCain of Okmulgee, have a daughter, Peggy, 12.

▸ **Richard L. Launder,** H & L Tooth Company, Montebello, California, is now in Texas, consulting with the company's Southeast Texas distributor, Browning and Ferris Company, Houston, Texas. Before returning to California, Launder, who is well known to pipe line operators and contractors throughout the country, will renew acquaintance with many old friends, and make an extensive tour of the Mid-Continent oil fields.

▸ **Cecil W. Stinemetz** has been promoted from assistant superintendent at the Clifton, Kansas, compressor station of Northern Natural Gas Company to compressor station superintendent at Hooper, Nebraska. He succeeds **W. A. "Al" Skinner,** who upon retirement by the company accepted a position with A. R. Jones Oil and Operating Company as general superintendent of its Pawnee Rock, Kansas, area gas production.

Stinemetz is succeeded at Clifton by **Fred W. Hammons,** who has been maintenance mechanic at Ventura, Iowa.

▸ **R. L. Wagner,** for the last two years assistant manager of the legal department of Shell Oil Company, Inc., in its New York office, has been named general counsel of Great Lakes Pipe Line Company, it is announced by Harry Moreland, president. Wagner assumed his new post February 1.

He has been a member of the legal department of Shell since December, 1939, except for 3½ years' service with the Navy during the war. He joined the oil firm at St. Louis and worked there and in Chicago prior to

R. L. Wagner

entering the Navy. His wartime record includes service in the Pacific as a deck officer in the gunnery department aboard an aircraft carrier. He participated in the action off Okinawa and Iwo Jima.

In going to Kansas City, Wagner will be returning to the midwest, having been born and reared in Oklahoma. He received his grade and primary education at Chandler, his birthplace, and in 1930 was graduated from Oklahoma U. Law School.

R. E. Kepke

Robert E. Kepke, vice president of The British-American Oil Producing Company and The Toronto Pipe Line Company, has been transferred to Toronto, Canada, as vice president of The British-American Oil Company, Ltd., in charge of the newly created department of supply and transportation. In his new position Kepke will have charge of the purchasing of all crude oil and its transportation from all sources of supply. This includes purchasing in the United States, Canada, South America, and the Middle East.

Kepke is a graduate in law from the University of Texas and before joining British-American on September 1, 1941, was in the attorney general's office in that state.

James D. Stirling, who in 1943 retired from Socony-Vacuum Oil Company, Inc., New York, died January 5 at his home in Sea Girt, New Jersey. Stirling had been traffic manager of Socony-Vacuum.

C. E. "Pete" Perkins, pipe line foreman at Columbus, Kansas, for Cities Service Gas Company, has been made foreman for the newly created Hutchinson, Kansas, district.

Jack W. Morton, of Cities Service Gas Company's compressor station office at Wichita, Kansas, has been assigned to supervise the construction of a new pipe line warehouse being built at Pratt, Kansas.

J. L. Martin and **Felix Chappellet** were honored by their colleagues in the General Petroleum Corporation Friday at a luncheon at the California Club on the occasion of their 35th and 25th service anniversaries respectively with the company.

Martin is vice president and director of the pipe line department. He joined General Petroleum in December, 1913. His first position was pipe line department superintendent.

Chappellet is assistant to executive vice president Clarence S. Beesemyer who, with executive vice president P. S. Magruder, was co-host.

J. R. Wait, Jr., formerly with Texas Eastern Transmission Corporation, has joined the Pan American Production, Gas and Pipe Line companies in Houston as chief engineer, E. R. Turner, president has announced.

Wait succeeds **P. F. Williams** who resigned in November to accept a position in Venezuela.

H. J. (Harley) Holcomb of the process engineering department of the Augusta, Kansas, refinery of the Socony-Vacuum Oil Company, Inc., has been transferred to the company's pipe line department at 26 Broadway, New York. He will be in charge of scheduling product movements through the lines. A native of Oklahoma and a graduate of Oklahoma Agricultural and Mining College, Holcomb started with Socony-Vacuum 20 years ago.

D. E. "Dick" Stearns, Shreveport, Louisiana, recently returned from a business trip to Argentina, South America, where he conferred with Pedro F. Rodriguez of Direccion General del Gas del Estado concerning the Stearns Electronic Holiday Detector. Also considered were matters pertaining to electrical protection on the Argentine government's 1100-mile line between Buenos Aires and Comodoro Rivadavia, which is nearing completion.

Starr Thayer, consulting engineer, Houston, Texas, recently returned to his office after two weeks in Los Angeles and San Francisco, California. His trip was for business and pleasure, he says, the business being research work for Owens-Corning Fiberglas Corporation.

Robert J. Ball has been appointed Port Captain of Sun Oil Company's marine department, Marcus Hook, Pennsylvania, according to **Charles L. Boyle,** marine department manager. Captain Ball, formerly master of the *SS Mercury Sun,* succeeds **Captain George R. Snyder** who retired from active service after 40 years with Sun.

Brown Booth, director of public relations for Tennessee Gas Transmission Company, Houston, and editor of that company's magazine, *The Line,* resigned January 1 and has been replaced by **Conrad Collier,** formerly public relations director for the Houston Chamber of Commerce. Booth resigned to go with Brown and Root, Inc., Houston, where he will handle that firm's public relations and advertising. Collier comes to TGT with 19 years of experience in newspaper and public relations work.

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For many years it has been necessary to use heavy pipe in order to secure strength at joints. WEDGE Chill Rings with the patented SPLIT Feature REINFORCES the joints—in fact they make the joints the strongest part of the line—in case of shock, strain or vibration the

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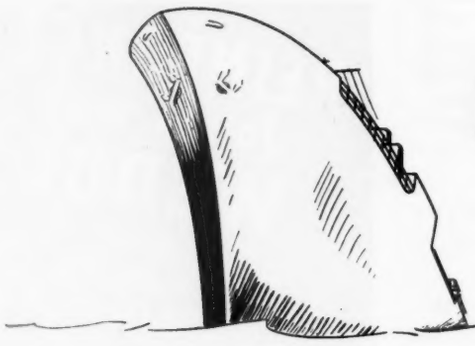


MARINE OPERATIONS

U. S. Flag Vessels Carried 48.9% ERP Cargoes in 1948

United States flag vessels carried 48.9 per cent of the 12,283,000 tons of ERP shipments from this country to Europe in the eight months period from April through November 1948, it was reported by an official ECA survey. American vessels carried 6,010,000 tons of bulk tanker and berth shipments, compared with 6,243,000 tons handled by foreign flag ships. Approximately 9,787,000 tons of bulk cargo were shipped; U. S. flag ships handled 4,942,000 tons or 50.5 per cent of these shipments, according to the Marshall Plan agency report.

Tankers under the U. S. flag carried 21.6 per cent of the petroleum traffic, while American vessels transported 57.7 per cent of the berth shipments from this country. Shipments by vessels of the American Merchant Marine to various ECA countries were as follows: France, 54.7 per cent; Italy, 51 per cent; United Kingdom, 15.1 per cent; Netherlands, 23.7 per cent; Greece, 76.4 per cent; Austria, 96.8 per cent; German Bizone, 86.4 per cent; Belgium, 32 per cent; French Zone of Germany, 8.8 per cent; Norway, 26.5 per cent; Denmark, 5.1 per cent, and 100 per cent to Trieste.

Motor Tankers Delivered

Delivered recently was the motor tanker *Nina Borthen* for A/S Motortank, Oslo, Norway, by Burmeister & Wain. The vessel, which has a loading capacity of 13,400 tons, made a speed of 14 knots on trials. Built to highest class of Norwegian Verita, her main dimensions follow: Length 465 ft. breadth 62 ft 10 in., depth to main deck 34 ft 8 in., draft 27 ft 4 in. Built with forecastle, bridge and poop, soft nose, and cruiser stern, she is partly welded. The vessel is divided into eight tank sections and has two main pump rooms, and there are four steam pumps, two capable of discharging 250 tons and two 390 tons per hr.

From Kockums Mek. Verkstad of Malno, Sweden, comes the report of the recent delivery of the new motor tanker, the *Beaufighter*, to Biorn Biornstad, of Oslo. Built to Lloyd's highest class, the vessel is of 16,250 deadweight tons, and has oil tanks with a capacity of about 770,500 cu ft as well as a dry cargo hold of about 24,000 cu ft. Main dimensions are: Length 487 ft, breadth moulded 48 ft 6 in., and depth of 35 ft. She is capable of a speed of 15 knots when fully loaded.

G-E to Supply Much Supertanker Equipment

Propulsion equipment for more than one-third of the tankers now being built or contracted for in U. S. shipyards will be supplied by the General Electric Company, according to a recent announcement by G-E. Most of the 20 vessels, representing nearly 350,000 gross tons of shipping, will be 12,500-hp supertankers. General Electric, it was stated, is supplying Newport News Shipbuilding and Dry Dock Company with double reduction gears for six 26,000 deadweight ton vessels in addition to complete geared turbine propulsion drives for five other tankers of the same size. Sun Shipbuilding and Dry Dock Company was listed next with having placed orders with G-E for four turbine propulsion drives rated 12,500 hp at 112 rpm. In addition, G-E is supplying propulsion reduction gears, mechanical drive turbines, motors, and switchboards for three 16,000-hp tankers being built by Welding Shipyard. Similar equipment for two other tankers of the same size has already been supplied to Welding Shipyard.

New Guinea Oil Terminal

Socony-Vacuum Oil Company, Inc. has announced that the Klamono oil field in New Guinea has been brought into production with the first delivery of crude oil at the port of Sorong in western New Guinea. Commercial production was made possible by completion of a 30-mile pipe line through dense jungle from the wells at Klamono to the newly constructed tidewater terminal at Sorong. Production is at the initial rate of 4000 bbl daily, it was reported.

British Tanker Equipped With the "Air" Process

The small tanker *Anglo-Mex II*, which is completely equipped with centerline bulkhead steam heating coils in the cargo tanks and oil-tight covers on deck for battening down, has been equipped with the "Air" process for tank cleaning, gas freeing, and oil separating. The "Air" system is in full operation on the Thames River for these services to vessels, and it is believed to be the most comprehensive equipment of its kind in Europe. The *Anglo-Mex II* has been classified with the British Corporation for loadline purposes and is fitted with a steam-operated cargo oil pump installed in a separate pumproom with an oiltight bulkhead; a fool-proof oil separator, also in its own compartment; a marine boiler supplying steam to tankers and other vessels for steaming out oil compartments preparatory to cleaning down and gas-freeing, as well as to heat the coils in the vessel's own tanks and to operate its pump; a generator for supplying electric light to ships being gas-freed, and self-contained air compressors and pumps.

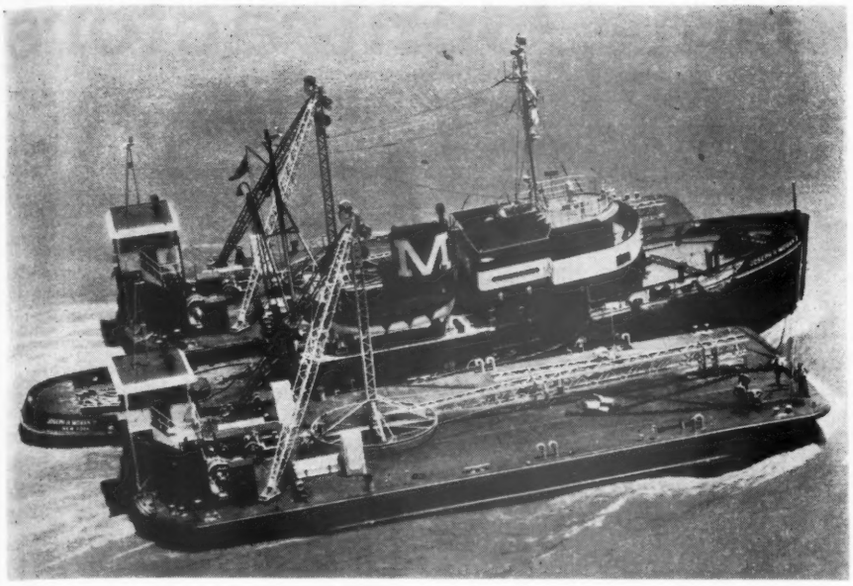
Award Winners

Three seamen in the Marine Transportation Department of the Socony-Vacuum Oil Company, Inc., divided several hundred dollars recently for award-winning ideas under the company's new suggestions system.

Hubert Coyle of Newark, New Jersey, a boatswain on a Socony-Vacuum tanker, won awards of $25 and $65 for suggestions to improve the rigging for cargo booms and for installing gratings over equipment used in cleaning barges.

Daniel Ronspees of Cleveland, New York, a mate on a powered barge, received $85 for suggesting a flashlight bracket on measuring tapes for gauging the contents of tanks aboard the vessels.

Charles Sheridan of Staten Island, New York, an engineer on a company tanker, was awarded $70 for the proposed use of a special electric voltage tester to be used on deep-sea vessels.



The "Joseph H. Moran II," one of the sturdy fleet of General Motors Cleveland diesel-electrics, which has covered 41,000 nautical miles in 5 months towing barges from New Orleans to Lake Maracaibo, Venezuela. The Moran Towing and Transportation Company has delivered 33 huge barges such as the derrick barge above to the Creole Petroleum Corporation project on Lake Maracaibo.

Moran Company Sets Towing Record

By using diesel-electric tugs for hauling barges from the United States to Venezuela, the Moran Towing and Transportation Company has established something of a record by covering 41,000 nautical miles in 5 months, according to a recent report.

The Moran company has been towing new floating equipment in connection with the Creole Petroleum Corporation's exploration and production program in Lake Maracaibo, Venezuela.

The area of the Creole operation extends for 50 miles along the northeastern shore and out into the lake for 10 miles. More than 1500 towing derricks are at work there. Gathering stations, absorption and compressor plants, as well as the derricks, have been built over water on pre-cast, monolithic-type concrete piling that sometimes reaches a depth of 185 ft, extending down to and below the lake bed. Paralleling the shore are piers, terminals, shops, foundries, cement works, shipyards, and other facilities.

Six Moran tugs operating principally between New Orleans and Maracaibo, from the latter part of March to the latter part of August, 1948, set up the 41,000 nautical mile towing record, which is the equivalent of 12½ trips across the North Atlantic from New York to Southampton.

Of the six Moran tugs used, five were General Motors Cleveland Diesel-electrics of 1900 or 1200 hp. Shuttling back and forth between 30 and 10.5 degrees north latitude, the "M" tugs delivered, in the five month period, 33 steel barges ranging in length from 65 to 174 ft, with maximum widths of 70 ft, and depths up to 12 ft. The operation is still underway.

The Creole Petroleum Corporation has built up and currently maintains a huge fleet of special marine equipment for the construction of foundations, drilling platforms and derricks, laying marine pipelines for gathering oil, and for miscellaneous requirements in connection with its extensive program. There are test, drilling and construction barges, motor-driven conveyors, mixing hoppers, pumps and manifolds, compressor barges and pile drivers, as well as speed boats, tugs, launches and other types of passenger and service craft.

There are, for example, 6 self-propelled derrick barges, 85 and 110 ft long; one 174 ft drill boat; three lighters, 65 and 85 ft long, two of them self-propelled; one 110 ft hopper barge, and 22 other barges ranging from 65 to 78 ft in length.

New Tanker Terminal Planned For Lake Maracaibo Area

Plans for a refinery capable of producing 35,000 bbl per day and provisions for an ocean-tanker terminal in Venezuela to process its crude production there have been completed by Standard Oil Company of California, it is reported. New refinery facilities will be near Lake Maracaibo and should be completed by 1950.

Private Shipyards Have 34 Tankers for 1949 Delivery

The private shipyards of the United States, January 1, had scheduled for delivery during the next two years 78 vessels of 1000 gross tons or over, aggregating 1,215,102 gross tons, according to the Shipbuilders Council of America.

During the current year 41 vessels, amounting to 593,162 gross tons, consisting of 34 tankers (560,360 gross tons), three trawlers, two dredges, and two ferry boats, are scheduled for delivery.

In 1950, 36 ships, totaling 603,940 gross tons, consisting of 30 tankers (510,640 gross tons), three combination passenger-cargo ships, two passenger liners, and one bulk freighter, will be delivered.

The only vessel scheduled after December 31, 1950, is one oil tanker of 18,000 gross tons.

Super-Tanker Launched

Recently launched by the Newport News Shipbuilding and Dry Dock Company was the super-tanker *Esso Suez* for Standard Oil Company (New Jersey), the first of ten giant-sized vessels being built by the Newport News yard for the Esso fleet. With a capacity of 230,000 bbl of oil, the *Esso Suez* is 628 ft overall, has a molded beam of 82 ft 6 in., molded depth of 42 ft 6 in. to the upper deck, and a draft of 31 ft 11 in. The 26,500 deadweight tonner is the largest tanker ever constructed at the Newport News yard and the first of a "mile of tankers" that will go down the ways at Newport News and into the world-wide service of Standard Oil Company (New Jersey) this year, it was stated.

Largest Swedish Tanker

Recently delivered to the Monacus Shipping Company of Kungsbacka, Sweden, by the Gotaverken shipyard, was the 23,450-ton motor tanker *Atlantic Queen*, the largest ship in the Swedish merchant fleet and Sweden's biggest vessel in length, beam, and deadweight tonnage. Introducing a new era in Swedish tanker history, she is considerably larger than the biggest tankers previously built by Gotaverken. Dimensions of the *Atlantic Queen* follow: Overall length, 593 ft 6 in.; moulded beam, 74 ft 6 in.; moulded depth 42 ft 3 in., and mean draft 31 ft 11 in. Cargo will be carried in 10 center tanks and 12 wing tanks with a total capacity of 1,046,500 cu ft. The tanker has a loaded speed of 14¾ knots.

WITH THE Pipe Line Contractors

Sheehan Pipe Line Construction Company, Tulsa, Oklahoma, began work February 5 on 55 miles of 22-in. from Patoka to Wood River, Illinois, for The Texas Pipe Line Company. J. W. Brown is superintendent. The company also has in progress 6 miles of 7-in. line for the Ohio Oil Company between East Sparta and Canton, Ohio. Also for Ohio, some refinery work is being done at Robinson, Illinois. Sheehan completed the first of this month 63 miles of 12-in. for Stanolind Pipe Line Company. This job was three loops between La Plata and West Alton, Missouri. The 110 miles of 12-in. for Buckeye Pipe Line Company from Cygnet and Cleveland, Ohio, also have been completed.

Midwestern Constructors, Inc., Tulsa, Oklahoma, has as its principal job at the present time Section 1 of Shell Pipe Line Corporation's Ozark Pipe Line System. The section extends from Shell's Cushing, Oklahoma, refinery to Chelsea, Oklahoma, 79 miles of 22-in. Construction began December 15 and the job is expected to be completed in May. M. T. Wilhite is the superintendent and the field office is at Cleveland, Oklahoma. Phone: 705 and 706.

When weather conditions in Pennsylvania permit, work will begin on 22 miles of 6-in., known as the Reading Spur, for Socony-Vacuum Oil Company, Inc. The superintendent will be Lyle S. DeWitt.

The 155 miles of 8-in. between Malvern, Pennsylvania, and Binghamton, New York, for Socony-Vacuum, was completed January 1. Lacy Walker and Richard Leonard were in charge.

G. G. Griffis Construction Company, Tulsa, Oklahoma, has completed a 460-mile reconditioning job for the Atlantic Seaboard Corporation and the Virginia Gas Transmission Corporation. This was a 20-in. main line from Bowling Green, Kentucky, to the Pennsylvania state line. The companies are a part of the Columbia Group.

Bill Morrison Contruction Company, Tulsa, Oklahoma, is laying a 95-mile gathering system in the Seminole, Oklahoma, area for Sinclair Pipe Line Company. The pipe is 4, 6, and 8 in. Work began January 26. The field office is at Seminole. Henry Arthur is superintendent and Ted Dunn timekeeper. The company also is laying 12 miles of 6-in. for Horowitz Pipe and Supply Company near Collinsville, Illinois. This work began January 24. Dewey Whitworth is superintendent and John Miller timekeeper.

Titsworth and Partain, Kilgore, Texas, began work January 24 on the reclamation of 5 miles of 8-in. line in the East Texas area for the Atlantic Pipe Line Company. The line extends from Atlantic's Horton tank farm to the Camps unloading rack. The contracting firm also is reconditioning 12-in. and 16-in. vacuum lines in the East Texas field for the Parade Company.

Williams Brothers Corporation, Tulsa, Oklahoma, has small crews doing miscellaneous town work for the East Ohio Gas Company in Cleveland, the Louisville Gas and Electric Company in Louisville, Kentucky, and the Atlanta Gas Company in Atlanta, Georgia. All other work was completed at the end of the year or postponed because of weather conditions.

Younger Construction Company, Inc., Midland, Texas, is working on a gathering system for the gasoline plant at Eunice, New Mexico, of the Gulf Oil Corporation, Gypsy Division. This consists of approximately 40 miles of line varying in diameter from 2 to 30 in. Work began January 15. J. L. Perry is foreman and Dan Johnston line foreman. They are making their headquarters at Eunice.

O. C. Whitaker Company, Fort Worth, Texas, has been awarded a contract by Interstate Oil Pipe Line Company to lay 17 miles of 12-in. and 5 miles of 8-in. crude oil pipe line in southern Oklahoma. The 12-in. will be an extension of the company's 12-in. trunk line from Panther Creek Junction to Oklahoma City. The 8-in. line will extend from a point near Foster to a point immediately south of Elmore City. A field office has been established at Wynnewood with F. L. Byers as superintendent and J. O. Rogan as office manager.

Morrison Construction Company, Austin, Texas, is progressing with its work on Phillips Pipe Line Company's 12-in. line from Borger to Goldsmith, Texas. J. W. Hatcher is the superintendent, with the field office at Panhandle. At Pettus, Texas, this contractor is laying 75 miles of repressuring lines for Stanolind Oil and Gas Company. R. L. McMillon is the construction superintendent.

A. C. Holder Construction Company, Tulsa, Oklahoma, has begun work on the 382-mile, 10-in. crude oil line from Crane in West Texas to Refugio in the Gulf Coast area for Atlantic Pipe Line Company. The field office for the contractor is at Beeville and A. C. Holder is in charge personally.

Wood Engineering and Construction Company, Tyler, Texas, is laying 8 miles of 8-in. line near Carthage in Panola County, Texas, for the Sun Oil Company.

Wright Construction Company, Lovington, New Mexico, is laying 26 miles of 8⅝-in. pipe for The Texas-New Mexico Pipe Line Company in Andrews County, Texas. The line is being laid from Shafter Lake station to a point 26 miles southwest.

E. J. Mahoney Contracting Company, Mt. Pleasant, Michigan, is laying 75 miles of 12 and 20-in. pipe for the Michigan Gas Storage Company. This work consists of 61 miles of 20-in. from Pleasant Lake, Michigan, to Laingsburg, and 14 miles of 12 and 20-in. from the latter point to Lansing. The project is expected to be completed early in June.

Anderson Brothers Corporation, Houston, Texas, is laying 201 miles of 22-in. pipe for Shell Pipe Line Corporation on its Ozark Pipe Line System, from Roxdale station to Wood River, Illinois. Dual crossings will be made of the Missouri and Mississippi rivers and a single crossing of the Gasconade River. The contractor is working three spreads and has his central field office at St. Charles, Missouri.

Eastern Construction Company, Dallas, Texas, has been delayed to some extent by ice and snow, but the Lone Star Gas Company line between Opelika and Dallas, Texas, is about half completed. This is 70 miles of 20-in. line. J. W. Arthur is superintendent and Fred C. Harwell manager of the field office.

Britton Contracting Company, Fort Worth, Texas, has under construction 30 miles of field work at Playsville and Washington, Pennsylvania, for the Manufacturers Light and Heat Company, consisting of takeup and relaying 6, 8, 10, and 12-in. pipe. Roy Clark is in charge of the field office, which is at Playsville.

R. H. Fulton and Company, Lubbock, Texas, expect to complete about March 15 the five loops of 26-in. line being laid for Panhandle Eastern Pipe Line Company in Kansas. The loops are being laid from Liberal toward Kansas City and total 114 miles. Two spreads are working. Field offices are at Liberal and Newton.

Latex Construction Company, Houston, Texas, is now engaged in taking up and yard reconditioning 270 miles of 6-in., 8-in., and 10-in. pipe, for The Texas Pipe Line Company in the Houston - Liberty - Beaumont, Texas, area. H. L. Leake in charge of take-up near Beaumont, Sam B. Harrison, office; H. E. Murphy in charge of rack near Beaumont, J. J. Nolan, office; E. C. Norris and J. A. Williamson in charge of take-up and rack at Liberty and East Houston, R. Axsom and L. F. Redfearn, office. Work is 95 per cent completed.

Forty miles of 6-in. and 8-in. is being laid for The California Company near Ruston, Louisiana. F. A. Silar is in charge. Work began February 10.

Dunn Brothers, Dallas, Texas, stringing contractors, are stringing 70 miles of 20-in. pipe between Opelika and Dallas, Texas, on the Lone Star Gas Company job. The general contractor is Eastern Construction Company of Dallas. Clifton Hammett is superintendent for Dunn Brothers and the field office is at Terrell, Texas.

The company also is stringing 95 miles of 24-in. pipe for El Paso Natural Gas Company from Kermit toward the Upton County station. L. L. Rowland is superintendent of the job. The field office is at Kermit.

Smith Contracting Corporation, Fort Worth, Texas, is working two spreads on the 157 miles of 22-in. being laid for Shell Pipe Line Corporation on its Ozark Pipe Line System. This section extends from the Verdigris River, Rogers County, Oklahoma, to Buffalo, Missouri. Warehouses and field offices are at Vinita, Oklahoma, and Neosho, Missouri. F. A. Smith is general superintendent, Fred Peters is spread superintendent, and Ivan E. Steele office manager of Section 3, and Mirl Rumsey is spread superintendent and Ben L. Mapes office manager of Section 2.

This contractor also is laying 170 miles of 24-in. pipe for The Texas Pipe Line Company between Wichita Falls, Texas, and Cushing, Oklahoma. C. C. Craig is superintendent and H. G. Breckenridge office manager.

New England Transmission Company Organized

New England Gas Transmission Company has been organized by Massachusetts interests for the purpose of distributing natural gas at wholesale.

The company expects to obtain natural gas from the Tennessee Gas Transmission Company when that company extends its pipe line system into New England, which it is hoped will be accomplished by 1952.

Tennessee has an application pending before the Federal Power Commission for a pipe line to Buffalo. The company originally planned to run the line into Massachusetts to a point outside of Boston, but it has temporarily shelved this phase of its extension program.

Suez Canal Convoy System Studied by Authorities

Authorities of the Compagnie Universelle due Canal Maritime de Suez are now giving consideration to a proposal that would provide for two daily convoys of not more than nine vessels each. Hours of entry from Port Said under this proposed Canal regulation would be 00.01 hr to 01.40 hr, and 12 noon to 1.40 p.m. Recent announcement of projected Suez Canal improvements by the directors of the Compagnie Universelle due Canal Maritime de Suez indicated that the number and size of ships using the canal are constantly increasing and this, in the main, was ascribed to the considerable increase in tanker traffic between the Middle East and Europe. It is no longer possible to let ships proceed through the canal individually, consequently it has been found necessary to group ships in convoys of varying size.

Petroleum Distribution Unit A Part of Reserve Program

Organization of an engineer petroleum distribution company, under the army's affiliated reserve unit program, has been launched within the Stanolind Pipe Line Company.

The unit will have an initial strength of five officers, commanded by First Lieut. George B. Kimes, a Stanolind engineer. Present when J. L. Burke, president of Stanolind, signed the agreement were Col. C. H. Chorpening, Tulsa district engineer; Col. Rex L. Smith, Tulsa reservist and American Petroleum Institute co-chairman for the Fourth Army area, and Lieut. Col. Humbert F. Biasella, Tulsa senior instructor of reserves.

In event of emergency the unit would be expanded to 250 officers and men. This is one of a growing number of such units being organized within industries in northeast Oklahoma.

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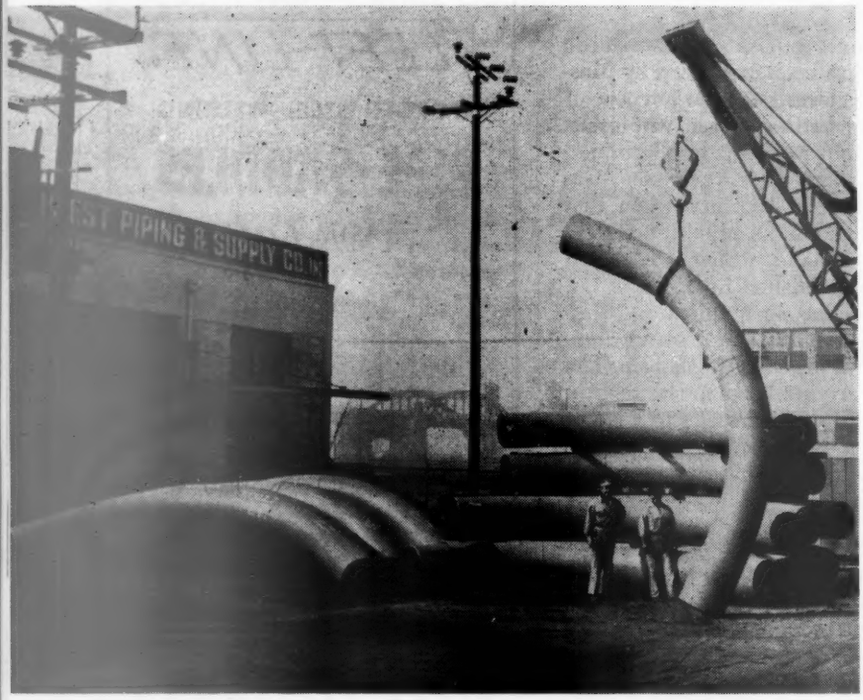


Giant 24-in. pipe bends fabricated by the Midwest Piping and Supply Company are prepared for shipment. The unusual bends were made for the Gulf Oil Corporation for use at its oil-loading dock facilities at Kuwait, Arabia.

A new compressor station has been placed in operation at Groesbeck, Texas, by the Lone Star Gas Company. Construction was by the Gasoline Plant Construction Corporation. Below are William J. Becker, left, Lone Star inspector on the project; Carl Johnson, construction superintendent, and A. B. Hemphill, Lone Star construction engineer.

Members of the Ohio Oil Company pipe line department from Illinois and Indiana gathered recently at the Terre Haute House for a service award dinner. Head of table: L. G. Greenwell; left table, left side, front to back: H. B. Copeland, Claude Doran, G. W. Ulrey; Lewis Duckworth, Vern Cooper, Cash Taylor, Fred Phillippe, E. A. Davis, Darrell Etnire, John Ault, James Swafford. Back table, left to right: H. T. Griffin, assistant division superintendent W. K. Smith, Fred Warren, (general superintendent, pipe line, eastern divisions), assistant division superintendent Max Stanfield, C. H. Bricker. Left table, right side, front to back: Oliver P. Lewis, William VanFossan, Harry McManimie, John Sporer, Ivan Bedell, Patrick Anderson, Joe E. Dean, supervisor of personnel, pipe line, eastern division. Right table, left side, front to back: W. K. McWherter, C. E. Page, C. E. Kurts, Milo Fessenbeck, Harold Ballinger, Albert Husted, Raymond Johnson, Marvin Hartman, O. C. Murphy. Right table, right side, front to back: Robert Willison, Elmer Cox, Coryden Mauk, F. P. Secrist, Virgil Anderson, Russell Kitchen, Jeff Walters, Ralph Ax, Raymond Curtright, G. A. Booher, Victor Johnson, Leo Martin.

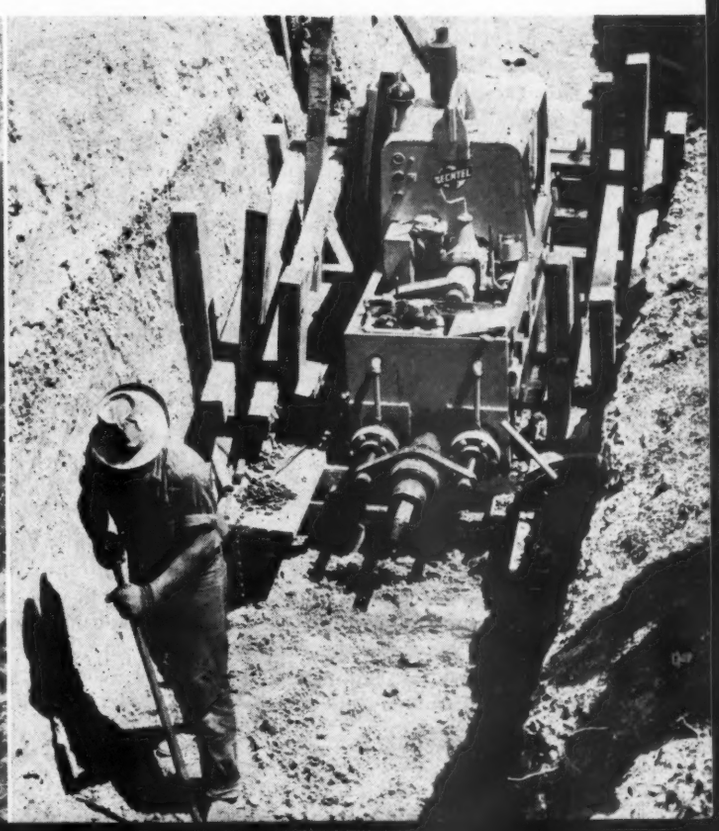
Pictorial

The above men recently figured in promotions by Stanolind Pipe Line Company. They are, left to right: J. R. Polston, new general manager; T. R. Aude, manager of planning and economics, who has been made a director; Cecil Hunt, general counsel, also made a director, and Jack S. Stearns, commissioner of the company's new tax department.

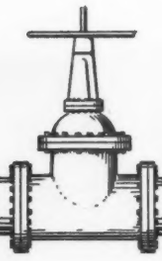
Ned H. Dearborn, president of the National Safety Council, presents D. M. Farrell of Shell Pipe Line Corporation, with the Council's plaque for first place in the petroleum section safety contest of the oil and gas pipe line section. Other safety men present are, left to right, L. W. Fisher, J. H. Reese, J. W. Hunt, E. M. McCracken, and H. D. Solsbery.

Workmen welding sections together of a new pipe line near Bangor, Maine. Extending 127 mi to Bangor from Socony-Vacuum Oil Company's marine terminal at South Portland, this is the state's first finished petroleum products line.

This Bechtel Corporation borer was recently in operation on the Tennessee Gas Transmission Company's spread near Jasper, Texas. The boring machine is shown at the highway 96 crossing between Jasper and Pineville.



PIPE LINE PROJECTS



California Commission Approves Gas Line

Construction of a pipe line to transport natural gas to California has been approved by the state public utilities commission. The line will be either 30 or 34 in. in diam, and will cost approximately $65,000,000.

The line will be 506 miles long from where it crosses the state border at Needles, California, and Topock, Arizona, to the San Francisco bay region. It will bring gas from the San Juan basin in New Mexico, and also from the Permian basin in New Mexico and West Texas.

El Paso Natural Gas Company and its subsidiary, the San Juan Pipe Line Company plan the line. Pacific Gas and Electric Company will take over at the border, and is under contract to complete construction of the California leg by January 1, 1951.

Gas Construction Approved

The Federal Power Commission has authorized Atlantic Seaboard Corporation and Virginia Gas Transmission Company, both subsidiaries of Columbia Gas System, Inc., to construct additional natural gas transmission facilities for the purpose of supplying the increased requirements of existing utility customers of the two companies in West Virginia, Virginia, Maryland, and the District of Columbia.

The facilities authorized include 268 miles of 26-in. pipe line extending from Clendenin, West Virginia, to Rockville, Maryland, a multiple crossing of the Potomac River near Rockville, and additional measuring and regulating equipment at various points on the line. The portion of the line to be constructed in Virginia, approximately 75 miles in length, will be built by Virginia Gas Transmission Company. The 193 miles of line in West Virginia and Maryland will be built by Atlantic Seaboard. Total cost of the facilities is estimated at approximately $20,000,000.

The proceeding on the joint application of the two Columbia System companies, which had been consolidated with the proceeding on an application by Tennessee Gas Transmission Company last May, was the subject of public hearings last summer and of oral argument before the commission in September. In approving the application of the Columbia companies the commission severed this proceeding from the one involving Tennessee Gas.

The Commission's order provided that the proposed new line, which will connect with Atlantic Seaboard's existing main line at Rockville, must be completed by March 1, 1950. The two companies, which have main offices in Charleston, West Virginia, jointly own and operate a 421-mile pipe line from Boldman, Kentucky, to a point on the Maryland-Pennsylvania state line near the Susquehanna River.

Increase Output Line Pipe Estimated for 1949

Production of line pipe during 1948 was 2,221,084 tons as compared with 1,200,000 tons in 1947 and 796,000 tons in 1940, according to the U. S. Department of Commerce's Office of Industry Cooperation. Estimated 1949 production is 2,553,517 tons, 246 per cent more than the prewar average, with a possibility that this may be increased to 2,675,617 tons.

Hearing Rescheduled

FPC scheduled a hearing to begin May 16 in Washington, D. C., in the proceedings involving applications by Southern Natural Gas Company and Atlantic Gulf Gas Company to construct and operate natural gas transmission facilities.

Southern Natural, which has main offices in Birmingham, Alabama, is seeking authorization to construct a 375-mile pipe line extending from the Gwinville field, Mississippi, to Atlanta, Georgia, with extensions to LaGrange and West Point, Georgia, and Lanett, Shawmut, Langdale, Fairfax, and Riverview, Alabama; a 225-mile trunk line extending from the Gwinville-Atlanta line to Colfax, Georgia, with extensions to the areas of Tallahassee and Jacksonville, Florida, Savannah, Georgia, and Georgetown, South Carolina. Estimated cost of the project is $43,625,895.

Atlantic Gulf proposes to construct a 1530-mile line extending from Mississippi to the Georgetown, South Carolina, and Jacksonville, Florida, areas. The company, which has offices in Shreveport, Louisiana, estimates costs at $57,126,000.

Seeks Interest in Coastal Pipe Line

Southern Natural Gas Company, Birmingham, Alabama, has asked SEC for permission to acquire a half interest in a new corporation, Coastal Pipe Line Corporation.

The new corporation was organized to construct a pipe line from Texas that would serve Southern Natural's system as well as other areas on the Atlantic Seaboard.

Southern wants to acquire up to 125,000 shares of Coastal's initially authorized 250,000 shares of common capital stock at par value of $1 each.

Southern has notified the commission it will soon file a plan to dispose of its public utility subsidiary company. The company says that if the commission does not grant an order to show that it has ceased to be a holding company, it will offer the Coastal stock to other Coastal stockholders at the best price offered by outside interests.

Oral Argument Scheduled

The Federal Power Commission has ordered intermediate decision procedure omitted and has scheduled oral argument for February 24 in Washington, D. C., in the proceeding involving applications of Texas Gas Transmission Corporation and Texas Eastern Transmission Corporation to construct natural gas facilities.

Consolidated hearings on the companies' applications opened in Washington, D. C., September 27, 1948, and were concluded January 14, 1949. Both Texas Eastern and Texas Gas requested omission of intermediate decision procedure and asked FPC to schedule oral argument. The commission's order fixed February 14 for filing of briefs by all parties who are to participate in the oral argument.

Texas Eastern, operator of the Big and Little Inch lines, is requesting FPC authorization to construct facilities to increase the delivery capacity of its system east of Middletown, Ohio, and also facilities in Texas and Louisiana to increase delivery capacity of the Little Inch line south of Lisbon, Louisiana. Texas Gas is seeking authorization to construct and operate a pipe line extending from eastern Texas to Middletown, Ohio.

To Enlarge System

In order to serve more adequately the rapidly developing Garvin and Carter county oil fields, Interstate Oil Pipe Line Company will enlarge its system in that area by constructing 17 miles of 12-in. and 5 miles of 8-in. crude oil pipe line in southern Oklahoma.

The proposed 12-in. line will be an extension of Interstate's present 12-in. trunk line from Panther Creek Junction, near the Antioch area, to Oklahoma City. It will extend from a point 7 miles south of Maysville station, where the present 12-in. trunk line ends, southward to the company's Tussy pump station, in the extreme northwest corner of Carter County.

The 8-in. line will extend five miles eastward from a junction point with the proposed 12-in., near the town of Foster, to a point immediately south of Elmore City, where it will connect with Interstate's existing gathering facilities in the Elmore City area.

The projected extensions are the latest in a series of improvements and expansions involving Interstate's two crude oil pipe line routes out of the productive Garvin County area. One major improvement previously completed was the construction of 47 miles of 12-in. line from Maysville to Oklahoma City, connecting there with the company's trunk line from Oklahoma City to Glenn Pool station near Tulsa. This line was completed in mid-January, 1948, and subsequently extended 7 miles south to Panther Creek Junction during February of the same year.

The contract was awarded to O. C. Whitaker Company of Fort Worth.

Gas Line Application

San Diego Gas and Electric Company is seeking Federal Power Commission authorization to construct and operate approximately 50 miles of natural gas pipe line as part of an 85-mile line, with Southern Counties Gas Company of California constructing the other 35-mile portion of the project. Southern Counties previously filed its application with FPC.

The overall line would connect with the existing Texas-to-California pipe line near Moreno, California, and would extend to San Diego. Estimated cost of the 50 miles of line to be constructed by the San Diego Company is $3,037,500, the application stated.

The San Diego Company said the proposed 16-in. line would increase deliveries from Southern Counties from approximately 33,000,000 cu ft to about 70,000,000 cu ft per day. San Diego Gas' portion of line would connect with Southern Counties' at Rainbow, in San Diego County, according to the application.

Elk Basin-Billings Line

Recognizing that the Billings-Laurel area is soon to become one of the principal refining centers in the Northwest, Interstate Oil Pipe Line Company has announced its intention of increasing the pipe line capacity into this territory by constructing a 12-in. crude oil pipe line from the Elk Basin field to the Montana centers.

To be approximately 70 miles long, the projected line will provide transportation for southern Montana and northern Wyoming crude to three refineries: Farmer's Union Central Exchange, Inc., refinery at Laurel, and the new refineries of The Carter Oil Company and Continental Oil Company that are now under construction at Billings. With the completion of the two new plants the total refining capacity will be about 36,300 bbl per day, and the currently owned Interstate 8-in. pipe line system, built by Yale Oil Pipe Lines, Inc., in 1944, will no longer have sufficient capacity to supply the daily crude oil requirements of these refineries.

The proposed 12-in. trunk line will have one pump station at the point of origin in the Elk Basin field. This will give the system an initial capacity of 40,000 bbl daily. Additional pumping equipment can be installed on the line to increase capacity as the need develops. Steel storage tanks totaling 100,000 bbl capacity will be erected at the pumping station.

Supervising the actual construction of the new line will be Herman S. Foote, superintendent of Interstate's Northwest district, offices in Billings.

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FPC Authority Granted

The Federal Power Commission has authorized three members of the Pittsburgh Group of the Columbia Gas System, Inc., to construct, purchase, and abandon facilities for the purpose of improving the operation of their systems in the interest of increased efficiency and flexibility. The three companies—Manufacturers Light and Heat Company, Home Gas Company, and Natural Gas Company of West Virginia—estimate total net cost of the project at $888,924.

As authorized by FPC, The Manufacturers Light and Heat Company will construct approximately 10½ miles of 12-in. pipe line from a point on an existing line near Canonsburg, Pennsylvania, to the Pittsburgh area; about 5 miles of 6-in. line in Ohio extending from Steubenville to Wintersville; two 500-psi compressor cylinders to replace existing 100-psi cylinders at the Waynesburg compressor station in Pennsylvania, and a 334-hp compressor station in Marshall County, West Virginia.

The Manufacturers Company also was authorized to abandon three 125-hp rotary-type compressors at Waynesburg Station; the Monessen and Turkey Hollow compressor stations in Pennsylvania, and approximately 17 miles of 8-in. pipe line in West Virginia and Pennsylvania; and to abandon and sell to Peoples Natural Gas Company 5339 ft of 8-in. gas transmission line in Westmoreland County, Pennsylvania.

Home Gas Company was authorized to acquire from the Keystone Gas Company, Inc., an affiliate, the Dundee compressor station and storage field in Yates and Schuyler counties, New York, and to install a 300-hp compressor station in Steuben County.

Natural Gas Company of West Virginia will construct about 5 miles of 8-in. line from the Brinker compressor station to the vicinity of Salem, Ohio, under the FPC authorization.

According to the joint application filed by the three companies, the projects will be completed by the spring of 1949. The companies said the facilities will be used to serve present customers, and not to extend service into new markets.

Asks Direct FPC Hearing

Texas Gas Transmission Corporation has asked the Federal Power Commission to pass directly on its application to construct an 800-mile natural gas line from Texas to Ohio.

The request, if approved, would eliminate the intermediate procedure requiring a recommendation by the trial examiner.

W. T. Stevenson, executive vice president of the company, filed a motion asking that the full five-member commission hear oral arguments on the application by February 15.

Texas Gas Transmission Finances Pipe Line

Texas Gas Transmission Corporation sold privately long-term bonds worth $60,000,000 to 12 insurance companies to finance its proposed 800-mile pipe line from the Carthage gas fields in Texas to a point near Middletown, Ohio.

According to W. T. Stevenson, executive vice president, the sale was made on December 23, and the money deposited with Chemical Bank and Trust Company, as trustee. The money will be available to Texas Gas Transmission on receipt of a certificate of public convenience and necessity from the Federal Power Commission.

The company also has entered into a standby bank loan agreement with three banks under which an additional $7,500,000 can be made available to finance construction of the proposed line. These banks are: Chemical Bank and Trust, Chase National, and The Bank of Manhattan.

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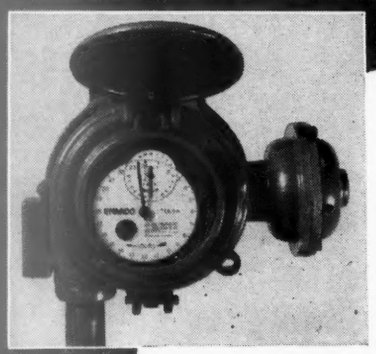

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PUBLICATIONS ON PETROLEUM AND NATURAL GAS BY THE U. S. BUREAU OF MINES

PART 2—1930-1948

See The Petroleum Engineer's Continuous Tables No. 139, for Part 1—1911-1929, published December, 1948

Arranged by years, list includes:

Bulletins (B)
Technical Papers (T P)
Reports of Investigations (R I)
Information Circulars (I C)
Special Reports
Cooperative Reports
Monographs (M)
Economic Papers (E P)
Periodical Reports

Asterisk (*) before title of publication means that it is reported out of print at present time. Others are available without charge from Information Division, Bureau of Mines, Washington, D. C., unless otherwise stated. Application for Periodical Reports are made to same division.

If price is given, money must be sent with order to Superintendent of Documents, Government Printing Office, Washington, D. C. Stamps are not accepted.

No money for publications should be sent to Bureau of Mines. *It does not sell reports.*

List does not include all papers written by Bureau of Mines staff and published in regular magazines of the oil and gas industry or in association periodicals; however, most of those published in 1947 and 1948 are listed and the names of the magazines in which they appeared are given.

1930

*B 318. Petroleum Refinery Statistics, 1928, *G. R. Hopkins.*

B 322. Effect of Vacuum on Oil Wells, *B. E. Lindsly and W. B. Berwald*, 35 cents.

B 323. Gas-Lift Method of Flowing Wells (California Practice), *H. C. Miller*, 30 cents.

*B 331. Permissible Methane Detectors, *A. B. Hooker, W. J. Fene and R. D. Currie.*

B 333. Refining of Light Petroleum Distillates, *H. P. Rue and R. H. Espach*, 25 cents.

T P 470. Results of Air Repressuring and Engineering Study of Williams Pool, Putnam-Moran District, Callahan County, Texas, *H. B. Hill*, 15 cents.

T P 475. Ignition of Natural Gas-Air Mixtures by Heated Surfaces, *P. G. Guest*, 20 cents.

T P 476. Stock Distribution and Gas-Solid Contact in the Blast Furnace, *C. C. Furnas and T. L. Joseph*, 30 cents.

*T P 477. A Study of the Lubricant Fractions of Cabin Creek (West Virginia) Petroleum, *H. M. Smith.* Chapters on the Action of Solvents on Heavy Constituents of Petroleum, *F. W. Lane, I. H. Nelson, J. M. Devine and H. M. Smith.*

*T P 480. Intensities of odors and irritating effects of warning agents for inflammable and poisonous gases, *S. H. Katz and E. J. Talbert.*

T P 483. Reforming Natural Gas, *W. W. Odell*, 10 cents.

*T P 488. Resistivity Measurements of Oil-Bearing Beds, *F. W. Lee and J. H. Swartz.*

*R I 2984. A Diaphragm or "Breather" Roof for Oil-Storage Tanks, *Ludwig Schmidt.*

*R I 2991. Cracking Natural Gas in Water-Gas Generators with Recovery of Carbon Black, *W. W. Odell.*

R I 2995. Twenty-First Semi-Annual Motor Gasoline Survey, *E. C. Lane, E. L. Garton, and O. C. Blade.*

*R I 2996. Apparatus for the Vacuum Distillation of Heavy Petroleum Oils, *Martin Gavin and Arch L. Foster.*

*R I 2997. Engineering Study of the Seminole Area, Seminole and Pottawatomie Counties, Oklahoma, *R. R. Brandenthaler, W. S. Morris, and C. R. Bopp.*

R I 3007. Use of Ethyl Mercaptan to Detect Leaks in Natural-Gas Distribution Systems, *R. R. Sayers, A. C. Fieldner, W. P. Yant, R. D. Leitch, and S. J. Pearce.*

R I 3008. Laboratory and Field Tests of a Permissible Methane Detector, *A. B. Hooker, W. J. Fene and R. D. Currie.*

*R I 3016. The Lower Limits of Inflammability of Natural Gas-Air Mixtures in a Large Gallery, *J. E. Crawshaw.*

*R I 3017. A New Flame Safety Lamp Testing and Demonstration Apparatus, *W. P. Yant, L. B. Berger, and G. S. McCaa.*

*R I 3022. The Use of Boiler Feed-water Heaters with Steam-powered Rotary Drilling Equipment, *C. E. Reistle, Jr.*

*R I 3026. A Survey of the Sulphur Content of Commercial Motor Fuels, *A. J. Kraemer.*

*R I 3027. Acrolein as a Warning Agent for Detecting Leakage of Methyl Chloride from Refrigerators, *W. P. Yant, H. H. Schrenk, and F. A. Patty.*

R I 3030. Tests of Ampoules filled with Palladium Salt Solution for Detecting Carbon Monoxide, *L. B. Berger and W. P. Yant.*

*R I 3031. Acrolein as a Warning Agent for Detecting Leakage of Methyl Chloride from a Multiple Refrigeration System, *H. H. Schrenk, F. A. Patty, and W. P. Yant.*

*R I 3035. The Recovery of Oil from Sands by the "Gas Drive," *Joseph Chalmers, I. H. Nelson, and D. B. Taliaferro.*

R I 3040. The Response of Japanese Waltzing Mice and Canaries to Carbon Monoxide and to Atmospheres Deficient in Oxygen, *W. P. Yant, F. A. Patty, H. H. Shrenk and L. B. Berger.*

*R I 3041. Review of Fatalities in the California Petroleum Industry during the Calendar Year 1929, *R. L. Marek.*

*R I 3042. Extinction of Methane Flames by Dichloro-Fluoro-Methane, *G. W. Jones and G. St. J. Perrott.*

*R I 3063. Twenty-second Semi-Annual Motor Gasoline Survey, *E. C. Lane, E. L. Garton, and A. J. Kraemer.*

*I C 6217. Bureau of Mines Instructions in First Aid, and Value of 100 Per Cent First-Aid Training to Employees of Mining and Oil Companies, *A. L. Murray.*

I C 6228. Railroad Fuel-Oil Consumption in 1928, *Arthur H. Redfield.*

*I C 6235. Comparative Advantages of Applying Several Geophysical Methods of Prospecting to the Same Territory, *F. W. Lee.*

I C 6257. The Work of the U. S. Bureau of Mines, *H. C. Fowler.*

*I C 6306. Nomographs for Calculating the Second Derivatives of the Force of Gravity Potential Obtained by Observations Made with a Torsion Balance at 5 Azimuths, *W. Ayvazoglou.*

I C 6310. Selected List of Bureau of Mines Publications Covering Safety Studies and Activities of the Electrical Section, *L. C. Ilsley.*

I C 6330. Some Hazards of Transporting Explosives in Automobile Trucks, *C. W. Owings and J. M. Harrington.*

I C 6333. The Cost of Accidents to Industry, *F. S. Crawford.*

I C 6349. Industrial Safety Training at a Mining School, *E. H. Denny and G. M. Kintz.*

*I C 6388. Possible Utilization of Natural Gas for the Production of Chemical Products, *H. M. Smith.*

*I C 6392. Conservation of Natural Gas in Relation to Some Recent Developments, *Scott Turner.*

*I C 6396. Sources and Distribution of Major Petroleum Products, Atlantic Coast States, 1929, *E. B. Swanson.*

I C 6415. Observations and Notes on the Effect of Methanol Antifreeze on Health, *R. R. Sayers and W. P. Yant.*

Manual of First-Aid Instruction. 20 cents.

*E P 9. Petroleum Coke, an Economic Survey of Its Production and Uses, *E. B. Swanson.*

Stimulating Production (Petroleum Engineering Handbook), *H. C. Miller.*

1931

B 339. Petroleum Refinery Statistics, 1929, *G. R. Hopkins.* 30 cents.

*T P 497. Electromagnetic Absorption by Rocks, with Some Observations Taken at Mammoth Cave of Kentucky, *J. Wallace Joyce.*

*T P 500. Relationship Between Volatility and Consumption of Lubricating Oils in Internal-Combustion Engines, *Gustav Wade and A. L. Foster.*

*T P 502. How to Compute Tables for Determining Electrical Resistivity of Underlying Beds and Their Application to Geophysical Problems, *Irwin Roman.*

*T P 504. Engineering Report on Cotton Valley Field, Webster Parish, Louisiana, *J. S. Ross.*

*T P 505. Influence of Fractionation on Distribution of Sulphur in Gasoline, *R. H. Espach and H. P. Rue.*

*T P 513. Studies on Determination of Sulphur in Gasoline, *R. H. Espach and O. C. Blade.*

*R I 3059. Development and Production History of the Salt Flat and Other Fault Fields of East Texas, *H. B. Hill, E. V. H. Bauserman, and C. B. Carpenter.*

*R I 3066. The Use of Aluminum for Oil Lease Tanks; Part I—Field Tests, *Ludwig Schmidt, J. M. Devine, and C. J. Wilhelm.*

R I 3074. Properties of California Crude Oils. IV—Additional Analyses, *A. J. Kraemer.*

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*Statistical Summaries of the California Petroleum Industry. (annual) Last issue.

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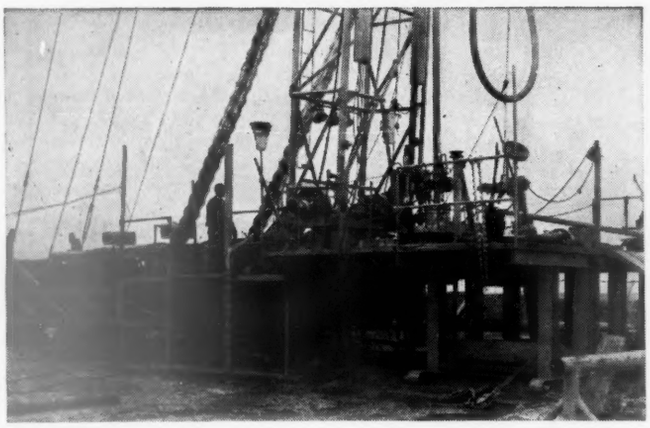

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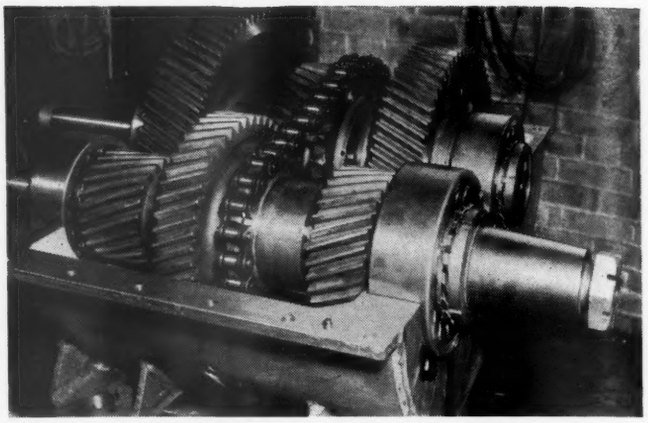

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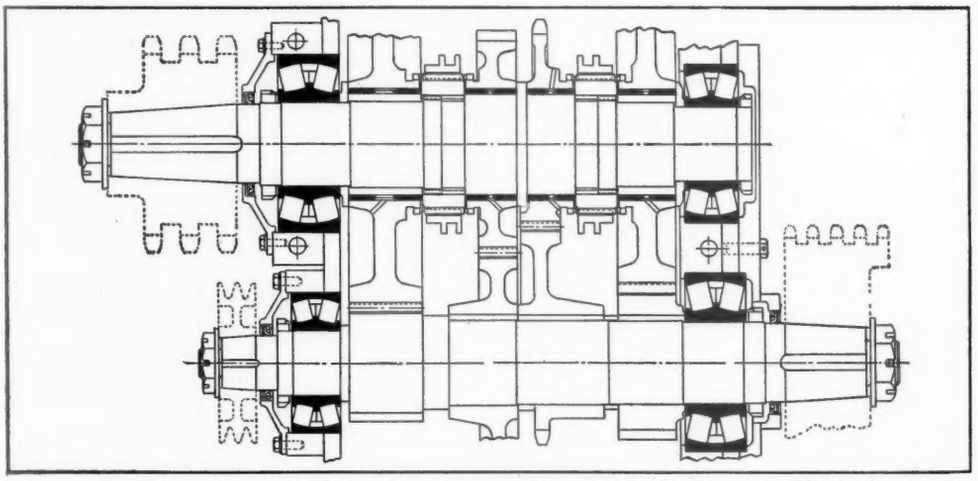

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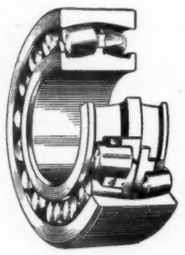

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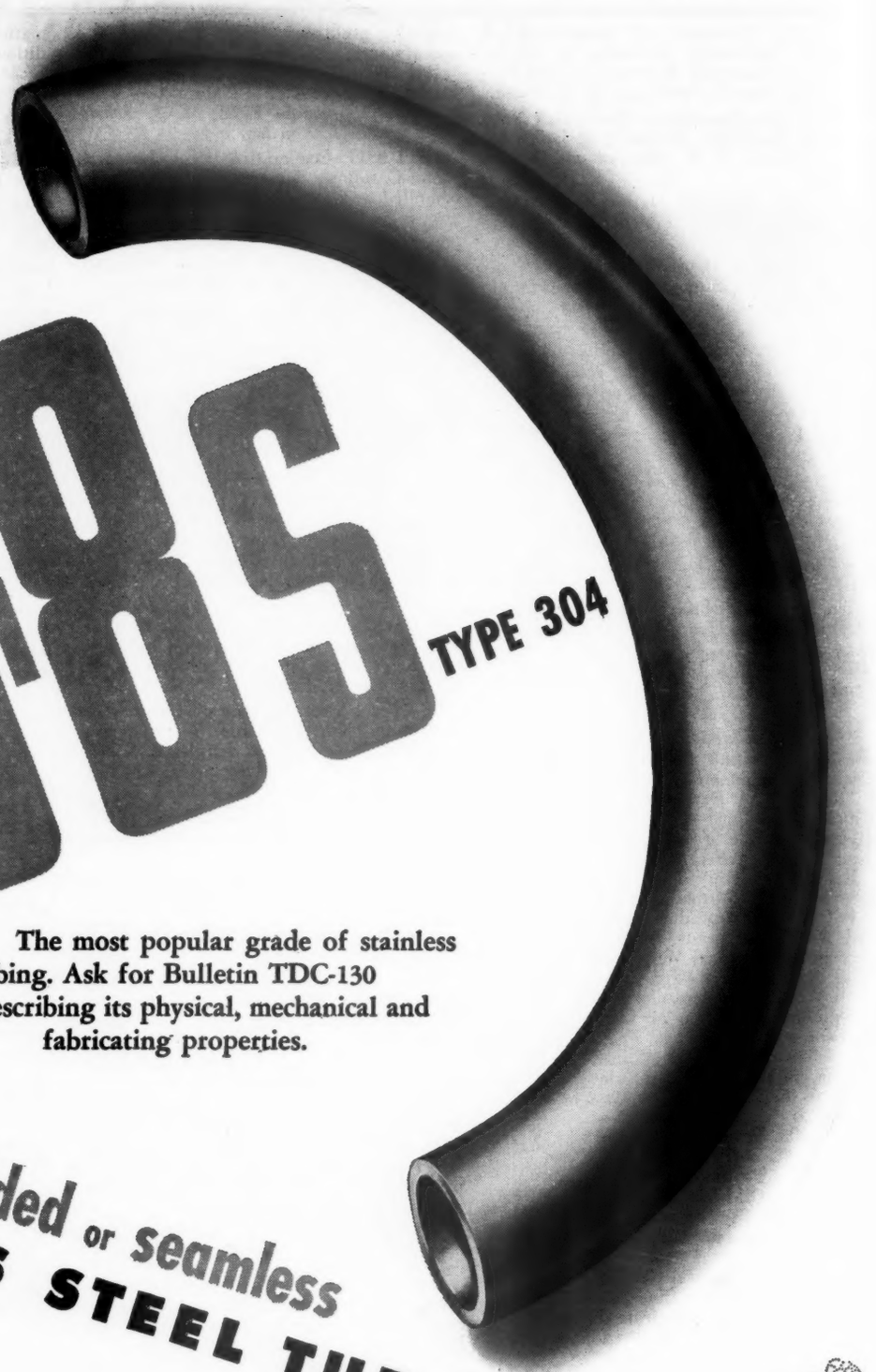

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Analyses of crude oils from: Atlanta District, Columbia County, Arkansas, March 23, 1939; Old Ocean Field, Brazoria County, Texas, March 31, 1939; Sparta-Wilcox Fields, Texas and Louisiana, May 5, 1939.

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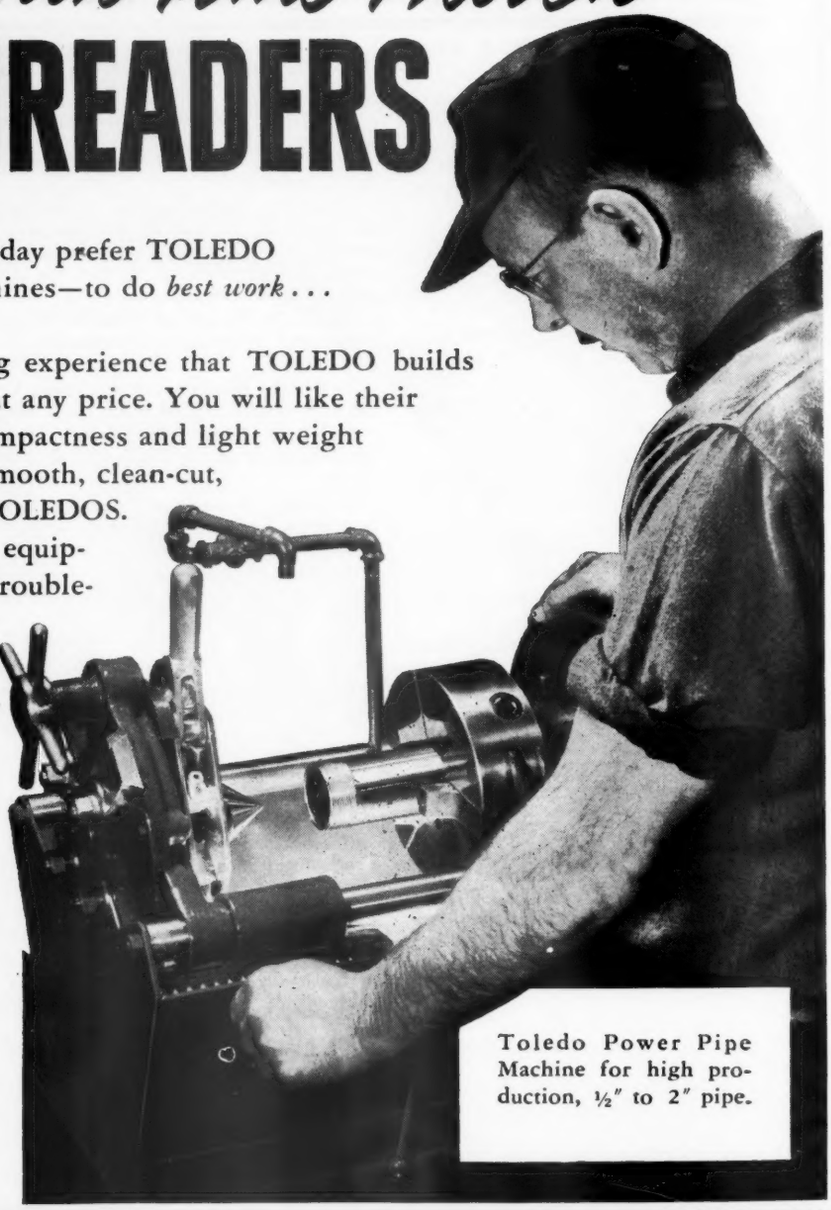

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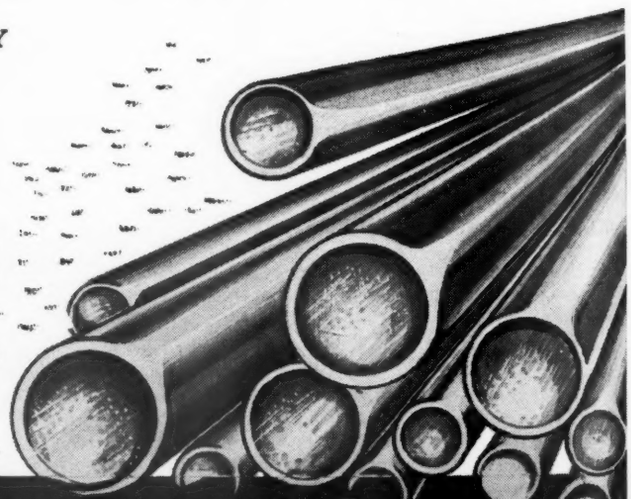

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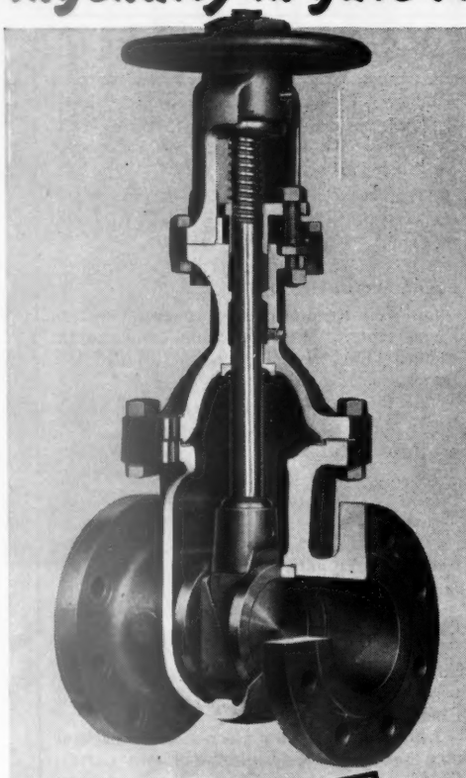

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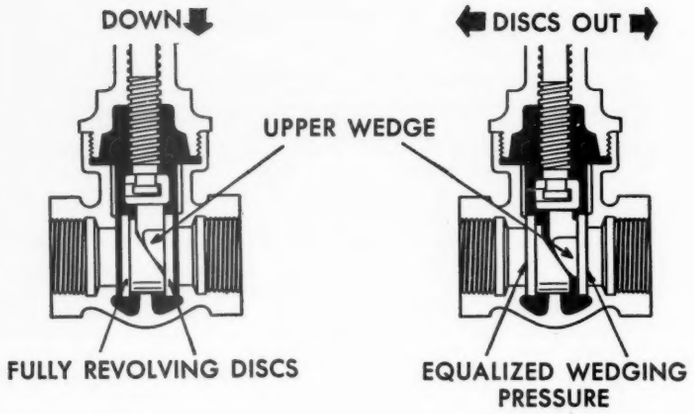


Regardless of years of hard, continual service, involving anything from extreme disc and seat wear to actual body distortion, this valve continues to give positive, leak-proof closure . . . and without strong-arm methods . . . an advantage found only in Darling Fully Revolving Double Disc Parallel Seat Gate Valves.

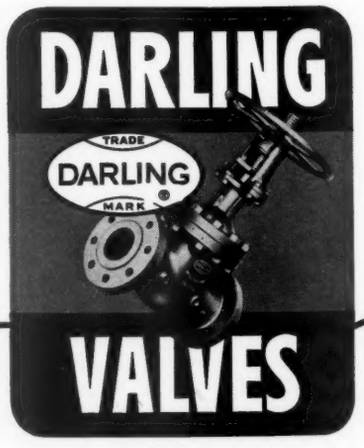
Note how the face of the upper wedge is radiused, while the adjacent face of the lower wedge is straight. Thus wedging pressure on the discs is automatically equalized, always uniform. If, because of body distortion, the valve seats become unparalleled, this unique compensating wedge principle still provides perfect seating and tight closure without forcing.

The discs themselves are free to revolve fully and seat in a different position at every closing. Uneven wear, another common cause of leaks, is definitely avoided.

Combine these unique features—automatic seating adjustment and uniform wear—and it's easy to see why these Darling Valves can always be counted on for positive, easy closing—regardless!

DARLING VALVE & MANUFACTURING CO.
Williamsport 2, Pa.

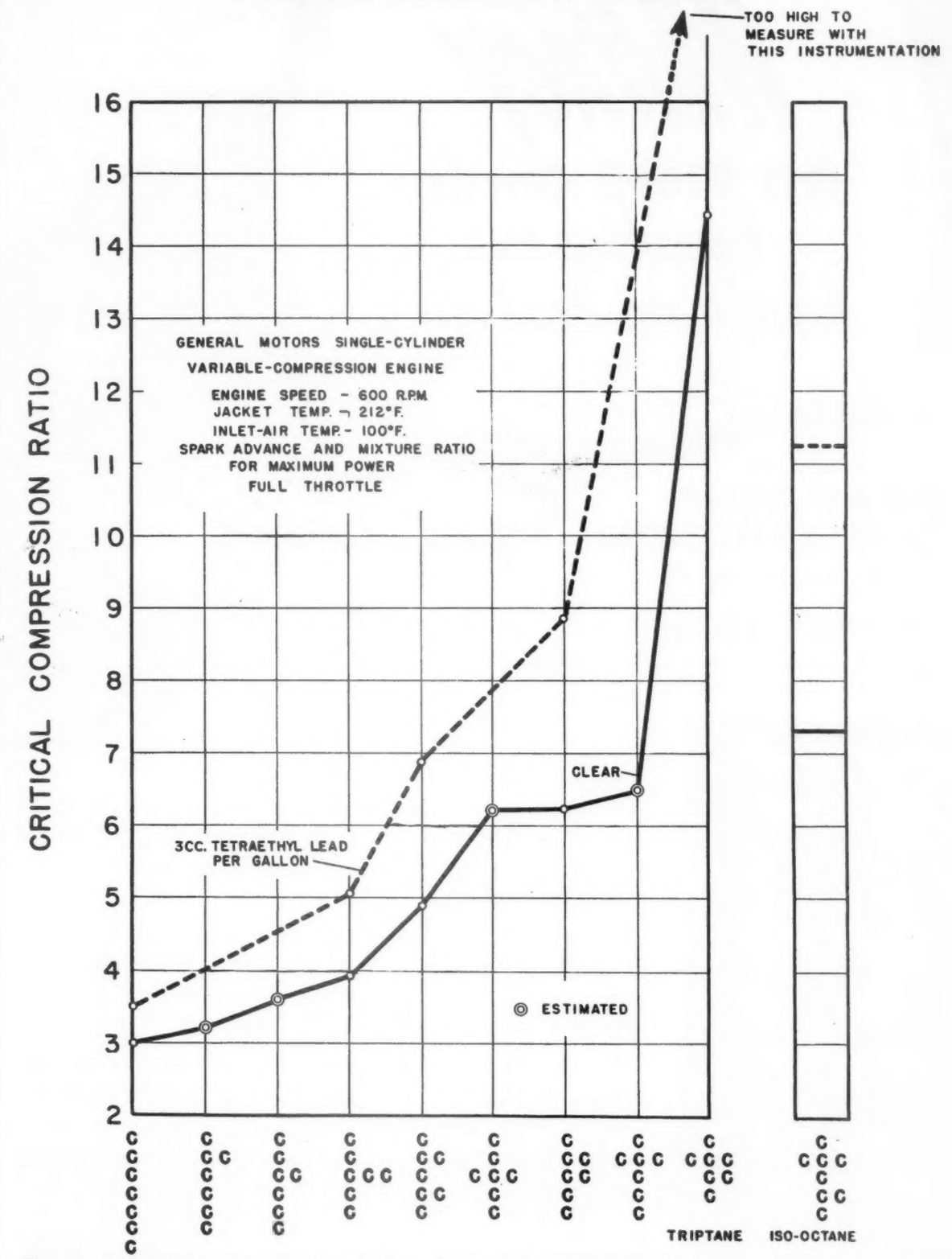
Outline your needs and ask for specific data on the proper Darling Valves... or send for the complete 300-page Darling Catalog No. 17M. It describes Darling Valves of *all* types and is full of valuable information.



THE VALVE MARK OF QUALITY . . . WATCH FOR IT

EFFECT OF MOLECULAR STRUCTURE OF ENGINE FUELS

KNOCKING CHARACTERISTICS OF THE HEPTANES



There is a fairly regular increase in the individual critical compression ratios as the structure of the molecule of heptane becomes more closely centralized or highly branched. Referring to the dotted line, the freer from knock the hydrocarbon is of itself, in general, the more effective lead is in making it still better.

Iso-octane is shown for comparison; note that it is only about half way up on the scale. The great effect of structures is shown in the behavior of 2,2,3-trimethylbutane (triptane), one of the best fuels known as far as knock is concerned.

Taken from the paper, "The Effect of Molecular Structure of Fuels on the Power and Efficiency of Internal Combustion Engines," presented by Charles F. Kettering, vice president, General Motors Corporation, before the American Chemical Society in September 1944.

Whitney

Oil Field Chains Keep Rigs and Equipment Producing

Featuring

SNAP-RING CONSTRUCTION

Assures Secure Fastening

OFFSET LINKS

For Easy Adjustments

No other chain gives you *more value* than the new Whitney Oil Field Assembly Chain. These tough rugged chains are built to give extra service in oil field service. All link parts are heat-treated steel assuring long life with minimum maintenance.

The new *Snap-Rings* assure positive fastening because they are tight . . . *stay* tight on the pins. They cannot shake off or vibrate loose as is often the case with cotter pins. The snap rings are easy to take off, easy to install.

The *Whitney Offset Links* make field adjustments for wear easy . . . all you need do is remove a link or two and you are ready to keep right on drilling.

Keep your drilling rigs and other equipment on the job with Whitney Chains. Write for the full facts today.

WHITNEY CHAIN & MFG. CO.

Division of Whitney-Hanson Industries, Inc.

217 HAMILTON STREET, HARTFORD 2, CONNECTICUT

Oil Country Warehouses located in Dallas and Los Angeles

ELECTRIC POWER GENERATION IN OIL FIELDS

Production methods. Common production methods include (a) engine-driven jacks; (b) central power units; (c) motor-driven jacks; (d) special types such as Reda pumps.

(a) Engine-driven jacks were the first to be used for commercial oil production. They are used extensively in pumping oil wells.

(b) Central power units utilize pull rod lines to connect a multiplicity of pumping jacks to one central mechanical power unit. These units are widely used for pumping groups of small shallow wells.

(c) Motor-driven jacks range from about 2 to 75 hp, common ratings being 5 to 25 hp. Motors are usually of the normal torque, normal slip, low starting kva type; however, high-slip motors, on the order of 5 per cent to 8 per cent slip are sometimes used. These motors are frequently installed outdoors and are then of splash-proof construction.

The starting current of the normal torque, low starting kva motors, on full voltage, will be about 5 to 5½ times full load current. On high slip motors, it will be about 4 to 4½ times full-load current. Operating power factor of a typical group of these motors varies from .55 to .70 lagging.

A nominal generating, distribution, and utilization voltage of 480 v is common. This voltage eliminates necessity for transformers and still makes it possible to serve a fairly large number of wells without excessive line loss.

Power generator for jacks. Common practice is to place one well in each 10-acre square. This results in a spacing of 660 ft between adjacent wells. A typical quarter-section layout is shown in Fig. 1. There are sixteen 7½-hp, high-slip (5 per cent to 8 per cent) motors. The generating equipment consists of two 50-kw, 3-phase, 60-cycle, 480-v, .80-power factor units operating in a parallel. *The longest run is approximately 2640 ft or ½ mile. This is about the practicable limit for 480 v distribution.* Eight 7½ kva capacitors are connected as shown, at end of the feeder lines. Disconnect switches are provided so operation at leading power factor at light loads may be prevented. Overall full load power factor is .84 lagging.

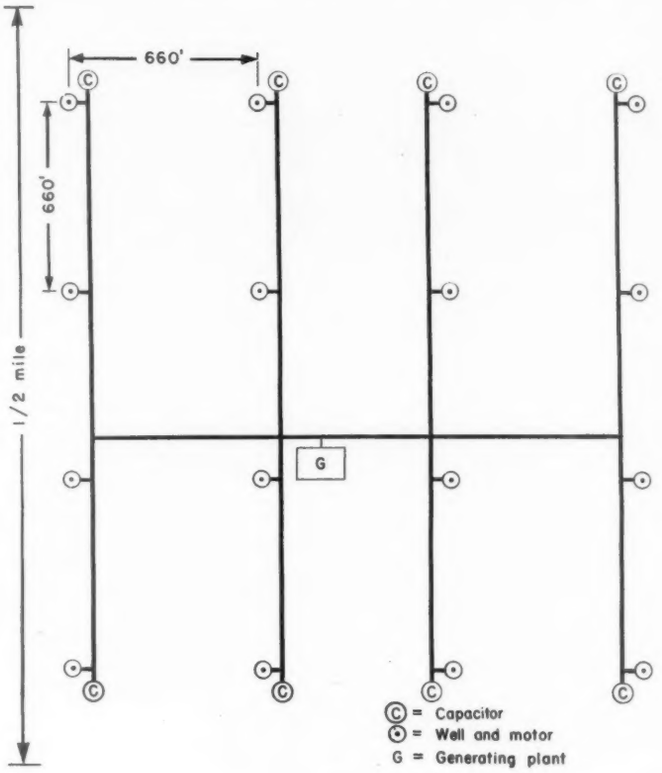


FIG. 1

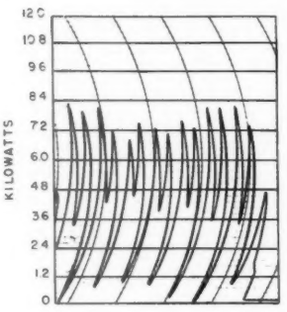


FIG. 2

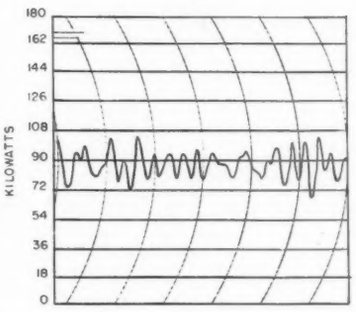
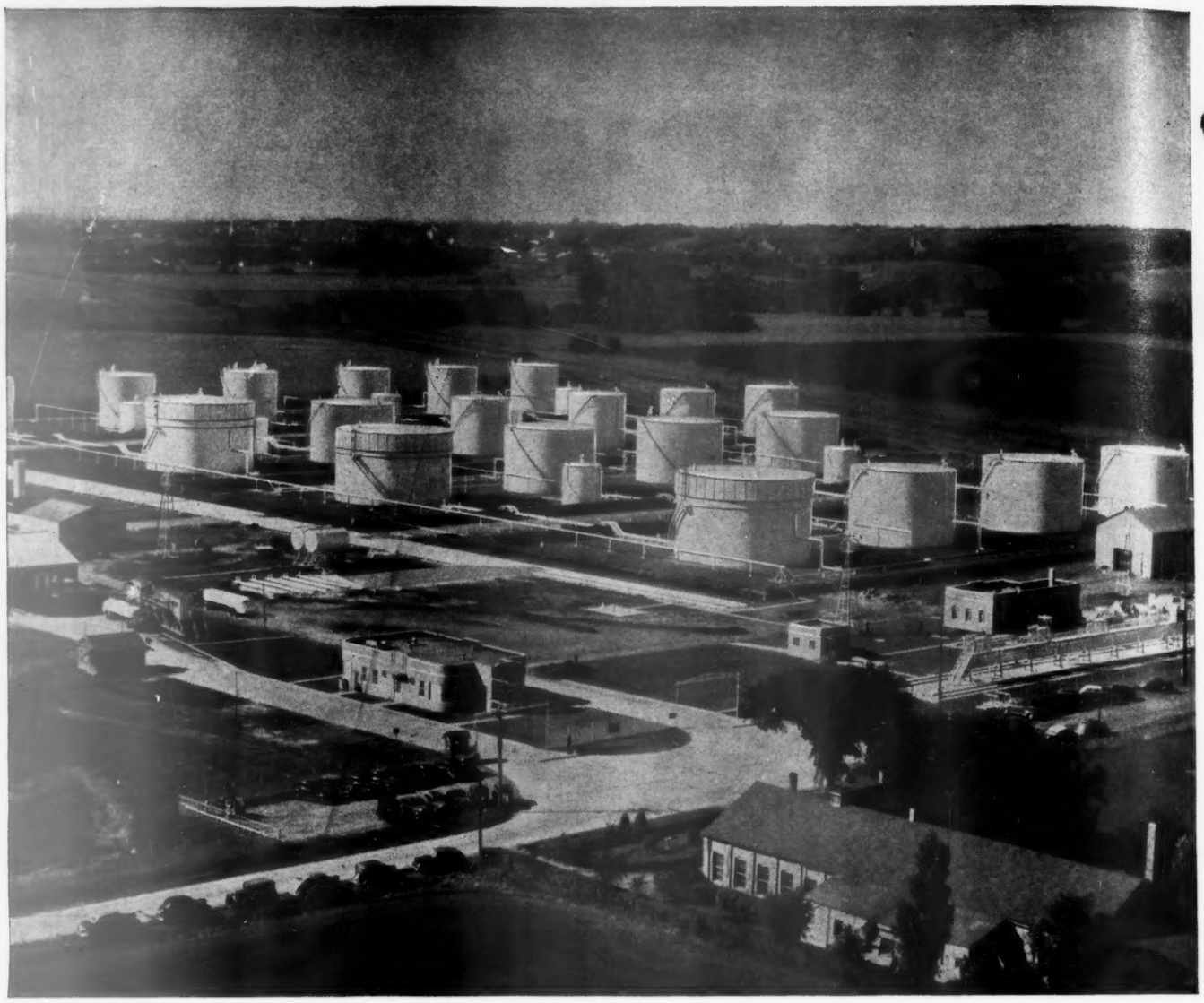


FIG. 3

Fig. 2 illustrates the load on one motor. Even though this is a fairly high-slip motor and the well is counterbalanced, there is wide variation in kw input. The average load is about 5.8 kw or 6.6 hp. It is obvious that a generator providing power for one such motor will be subjected to wide load swings. Also the generator must have sufficient kva capacity to start such a motor, at the same time maintaining a high enough voltage to develop the necessary torque to start the pump.

Fig. 3 covers a wattmeter chart on the 16 well layout mentioned above. The average kw load is 88 kw and the maximum swing is 36 kw. The total load is 105 kva at .84 lagging power factor. The generating plant having 100 kw capacity at .8 lagging power factor handles the load nicely. Without capacitors, the load would be 145 kva at .6 lagging power factor and substantially larger generators would be required.

Taken from the article "Electric Power Generation in Oil Fields," by G. L. Oscarson, Chief Application Engineer, Electric Machinery Manufacturing Company; published in *The Petroleum Engineer*, September, 1948, pages 66 to 74, inclusive.



LONG SHOT OF A SURE THING

This pipeline terminal is a sure thing when conservation of petroleum vapors is considered. Manifold lines connect three Expansion Roof tanks to the twenty-two cone roof tanks to give this terminal extra capacity to take care of the expansion of vapors due to rises in temperature or the displacement of vapors due to pumping in operations.

The manifold lines and tanks form a closed system, which holds the vapors under normal terminal operation . . . the daytime expansion of vapors being offset by pumping out and the night filling being offset by shrinking due to lower temperatures. Vapor pressures alone cause the Expansion Roofs to rise or descend.

Venting to the atmosphere and the intake of moisture-laden air are prevented . . . all standing losses and most filling losses are eliminated.

For the details on a sure thing for your petroleum storage facilities, write for the latest bulletin on the Expansion Roof.

FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

East Chicago, Indiana

Graver offers a complete service to the petroleum industry including Expansion Roof Tanks, Floating Roof Tanks and pressure vessels. In addition, Graver is prepared to furnish specialized steel plate work such as fractionating columns and class one vessels as well as stainless and alloy fabrication; water conditioning equipment of all types; and through the Graver Construction Co., is prepared to handle all types of petroleum and chemical construction work.

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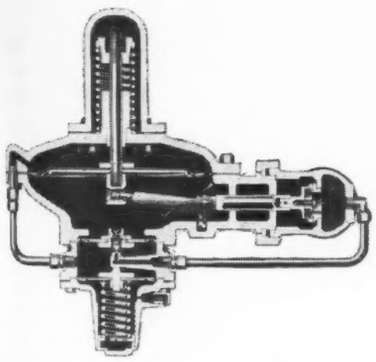
A REGULAR FEATURE
appearing in
THE Petroleum Engineer
Irwin-Keasler Building
Dallas 1, Texas

(1) Gas Regulator

Fisher Governor Company, Marshalltown, Iowa, has announced that the new Fisher Type 99 multi-purpose gas pressure regulator is now in production and available for immediate delivery. The regulator is extremely stable in operation over its entire pressure and volume range, and because



of this it is intended to serve many installations where before it has required several different types of regulators on these applications.

The regulator is available in 2-in. screwed pipe thread connections only, and is suitable for inlet pressures up to 150 lb and reduced pressures of four oz to 50 lb. The regulator capacity range runs from 0 up to 143,000 cu ft per hr, and is able to maintain a constant reduced pressure on all flows from 0 up to the maximum limit.

(2) Turbine Pump

A new turbine type pumping unit put on the market by the Roy E. Roth Company, Rock Island, Illinois is especially designed to meet requirements for a unit which would fit into a small floor space and still do the pumping job needed. The capacity of the pump is 2 to 10 gal per min.

(3) Mobile Health Unit

Free medical examinations are traveling via Fruehauf Trailer to all field employes, Humble Oil and Refining Company states.

As a preventive medicine service, the company has dispatched a complete laboratory housed in the 34-ft trailer, to call at each field where drilling is being done by Humble crews as well as to all other installations manned by company personnel. The unit contains sufficient facilities to handle about 20 complete physical examinations a day.

Periodic medical examinations for employes has been a policy of the Humble Company for years. In the past, however, the task has been performed by a traveling physician with portable equipment. The new unit was constructed to give the doctor more complete equipment for performing diagnosis.

Divided into three compartments—laboratory, X-ray room, and examining room—the clinic-on-wheels is equipped with electric air-conditioning and gasoline heating facilities. Transformers enable it to tie into outside electric power sources.

Included in the trailer is complete equipment for performing blood and urine tests, taking and developing X-ray pictures, and making comprehensive eye examinations. A fluoroscope, electro-cardiograph machine, sterilizer, and other diagnostic medical instruments are also included.

Get Full Details of February, 1949, Listing—Check and Mail Coupon to

THE PETROLEUM ENGINEER
P. O. Box 1589, Dallas, Texas

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NAME..... TITLE.....

COMPANY NAME.....

STREET ADDRESS.....

CITY..... ZONE NO..... STATE.....

(4) "O" Ring Seal

A new type of protection for sensitive pressure recorders, and indicators has been perfected by the Industrial Instrument Company of Odessa, Texas. It is the "O" ring seal, made for installation in the line between recorder outlet and measuring element. The "O" ring seal is designed to protect all types of gauge elements from corrosion, clogging, and shock of pulsations. This new protective device cuts down repair jobs as much as 80 per cent, thereby saving replacements costs and shut-downs, and increasing the life of instrument 5 to 1.

The "O" ring seal affords complete protection for pressure gauges of all kinds. Type H is engineered for operating pressures from 0-500 up to 0-20,000 psi, and can be used where mud, acids, corrosive mediums, and heavy viscous fluids are present, without the risk of clogging or corroding the measuring element. It acts as a pulsation dampener and can be used on vacuum. Type L "O" ring seals are for use on pressures from 0-50 in. H_2O up to 400 psi. Sizes available are ¼-in. and ½-in. NPT connections.

(6) Dynatherm Resistance Bulb

The Foxboro Company, Foxboro, Massachusetts, announces that the dynotherm resistance bulb is now in full-scale production and can be supplied with any Dynalog instrument. It is suitable for any installation for operating temperatures below 600 F. It can be installed to replace any thermocouple or filled-system bulb, in a well of ¼ in. diam or more and of any depth or any material. This adaptability results from the fact that heat transfer to the sensitive portion of the bulb is through its tip.

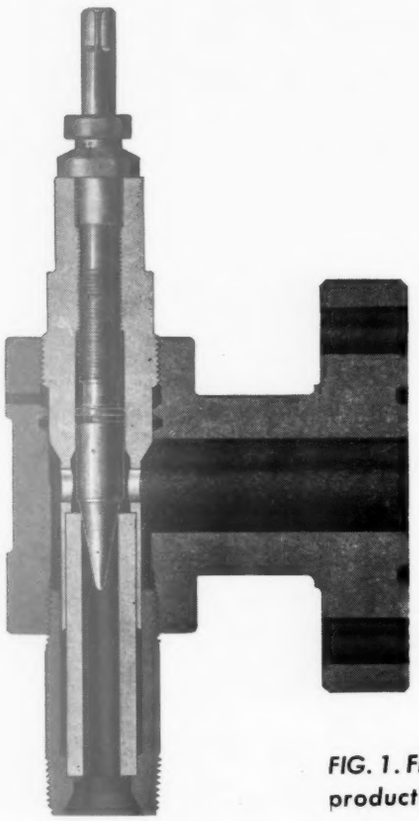


FIG. 1. Flanged type production choke.

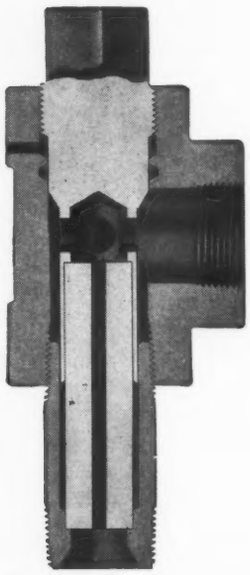


FIG. 2. Screw type production choke.

(5) Production Chokes

Cameron Iron Works, Houston, Texas has introduced a new model Christmas tree choke, Type G.

Illustrated in Fig. 1 is an API flanged type tee body fitted with the adjustable assembly, while Fig. 2 presents the positive bean with cage nipple assembled in a screw type tee body.

The positive or adjustable units can be interchanged in either housing, so that a well may be washed in thru the adjustable choke assembly which may then be replaced by a positive choke assembly for producing the well.

According to the manufacturer, another unusual feature of the Type G chokes is the fact that their design eliminates the need for a bean wrench. A pressure relief port is provided so that trapped pressure may be relieved automatically as the bean retainer is backed out of the body. All parts may be easily replaced at the well.

(7) Fire Extinguisher

An Alfco dry chemical type fire extinguisher has been announced by American-LaFrance-Foamite Corporation of Elmira, New York.

According to claims of the manufacturer, it has many new outstanding advantages such as longer range, longer duration of discharge, more complete discharge of the dry chemical contents, gas-tight, all-internal expelling gas connections, built-in safety disc, and is lighter in weight.

The dry chemical is nontoxic, noncorrosive, nonconductor of electricity, and will not freeze. The new unit has the Underwriters' Laboratories label and is rated B-1 and C-1. Recommended for flammable liquid and electrical fires. For putting out fires in motors, busses, trucks, trailers, gasoline stations, pits, garages and all similar industrial type risks. It is claimed its effectiveness is phenomenal.

(8) Cutting Torch Attachment

A new cutting torch attachment is now available for use with the Kinmont universal power unit, manufactured by the Kinmont Manufacturing Company, Inc., of Glendale, California.

The principal features of this attachment are its provision for easy and fast adjustment of the cutting torch in handling a wide rang of pipe sizes, and its ability to maintain a smooth bevel and a square cutoff across the end of the pipe.

(9) Aluminum Jacketing

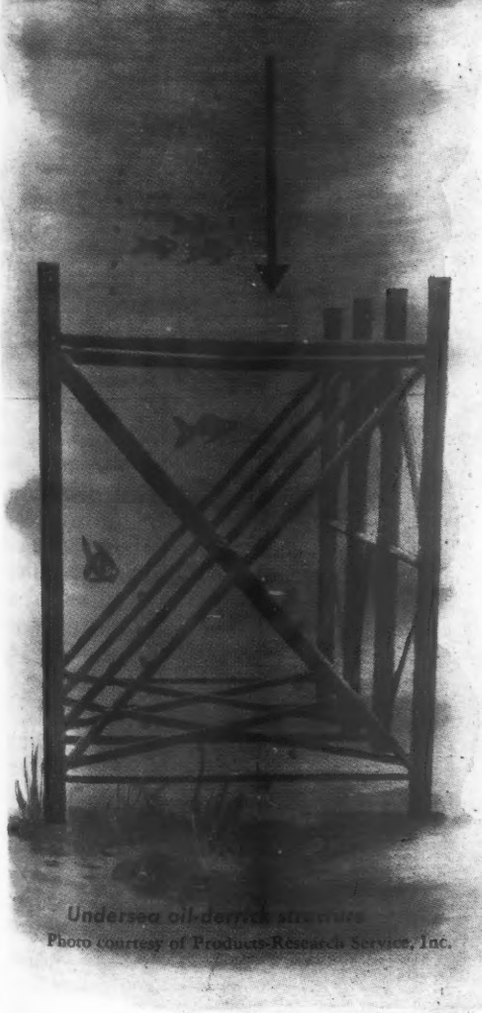
Childers Manufacturing Company of Houston, Texas, has scientifically designed aluminum jacketing for the protection of industrial insulated lines. The jacketing comes complete with moisture barrier attached. This needs no painting nor maintenance.

(10) Magnesium Ladders

The Aluminum Ladder Company, Worthington, Pennsylvania, has developed a new line of magnesium ladders for general industrial purposes.

In extensive tests, the new magnesium ladders have compared very favorably with their aluminum prototypes. Fabricated from a new alloy exhibiting the most satisfactory combination of rigidity, strength, corrosion resistance and wearing qualities, these ladders are as light and sometimes lighter than similar aluminum ladders. Like aluminum, they are spark-proof.

The new magnesium ladders include step ladders of all types, platform and warehouse ladders, and light and heavy duty extension ladders.



Undersea oil-derrick structure
Photo courtesy of Products Research Service, Inc.

OIL, SALT WATER, ACIDS, SULPHUR, SUN, AIR, ABRASION!

Sound impossible?

Today it is *achieved*—for the drilling platforms and equipment of several large oil companies in their search for oil off the Louisiana coast.

It is achieved by coatings formulated with VINYLITE Brand Resins which are giving unprecedented and almost unbelievable protection against corrosion and attack from sea water, air, and sun, and the buffeting of debris in pounding seas and the inevitable rough contact of small boats.

These are the same type coatings that, after two years on oil tanks and pipe lines in western Texas, proved to be virtually as good as new where 85% of other coatings were completely destroyed.

They are the same acid-, alkali-, and chemical-resistant coatings that have set impressive new records for economy in protecting tanks, pipes, and equipment throughout the chemical and processing industries.

VINYLITE Brand Resin coatings not only save the cost of frequent refinishing, but they remain intact despite long service—retaining their integrity and bond. They are equally effective for metals, concrete, and wood, protecting equipment from contamination by contents and contents from contamination by equipment. For the latest technical data and information on suppliers, write Department EM-57.

Vinylite BRAND **RESINS**

BAKELITE CORPORATION

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N.Y.

(11) Steam Gun

Oakite Products, Inc., New York, have announced the addition to the company's line of steam-cleaning equipment of the Oakite solution-lifting steam gun, Model 481, designed to facilitate volume cleaning operations in industrial plants.

The outstanding feature of this new gun, the manufacturers report, is its ease of handling, made possible by its special construction. The gun, with an over-all length of 5 ft, is ruggedly constructed and so balanced that it may be used over extended periods without tiring the operator. The steam gun, it is stated, develops sufficient vacuum to discharge cleaning solutions to a height of over 12 ft, to permit rapid thorough cleaning of large-equipment surfaces.

(12) Recording Instrument

A new recording instrument, known as the running-count recorder has just been announced by The Bristol Company, Waterbury, Connecticut. The newly developed recorder plots on a circular chart, a curve of number of operations against time. It records the total count of intermittent operations and the time at which each one occurs.

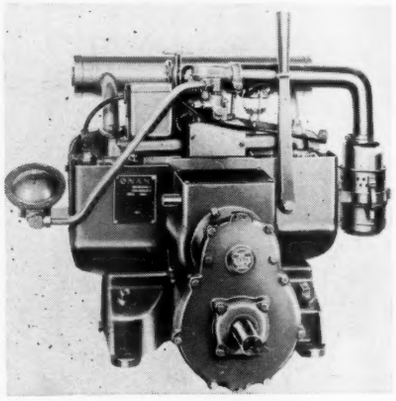
(13) Dual-Fuel Engine

A new 2-cycle, 21½-in. by 27½-in. dual-fuel diesel engine, has been introduced by Lima-Hamilton Corporation, New York. This engine is designed for operation on low-pressure gas with extremely low pilot fuel requirements, and is described as the first large, two-cycle, loop-scavenging engine to work satisfactorily on the low-pressure gas-injection principle.

(14) Oilfield Engine

Built for continuous heavy-duty service on tough oil field pumping jobs, a new 2-cylinder air-cooled pumping engine, to be known as the OIL-FIELDER, has been announced by D. W. Onan & Sons, Inc., Minneapolis, Minnesota.

Developing 1000 in. lb torque with a 960 ft piston speed, the OILFIELDER engine is rated at 5½ hp continuous duty (by API formula). Engine

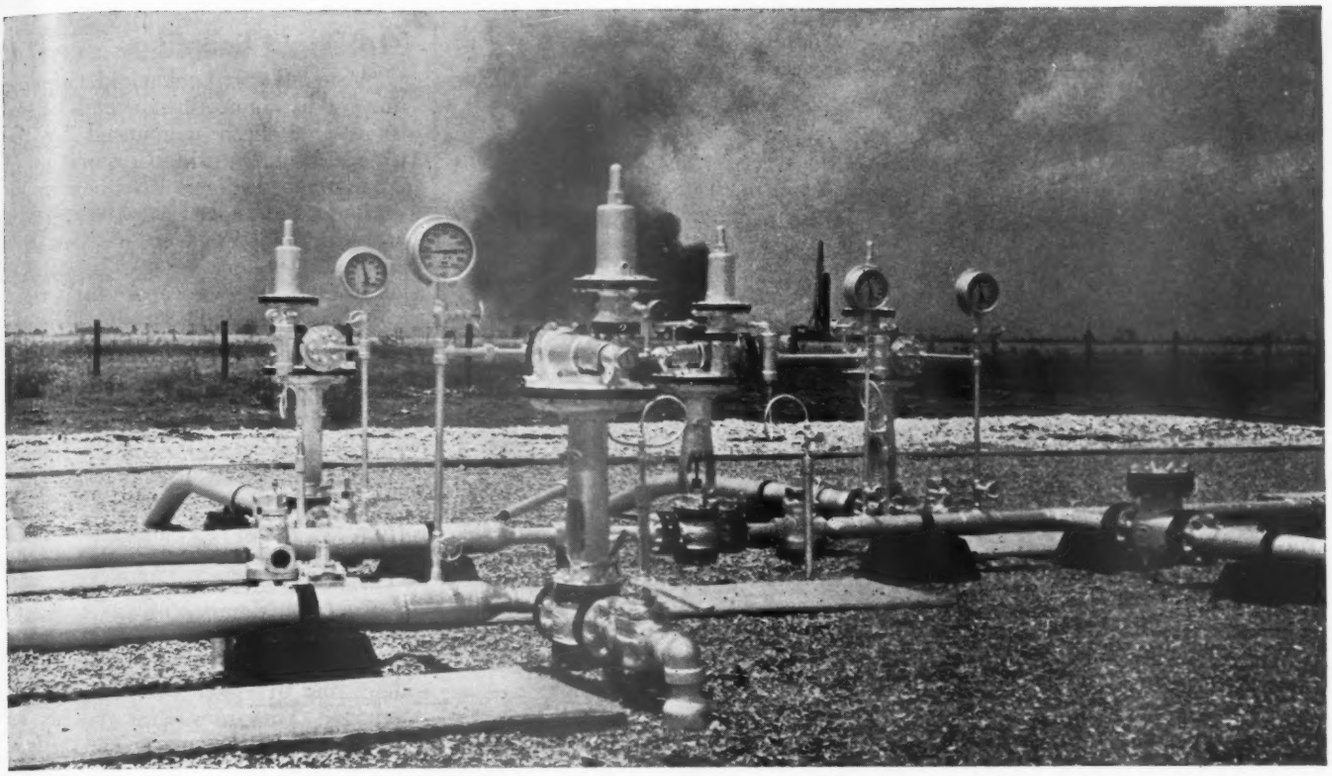


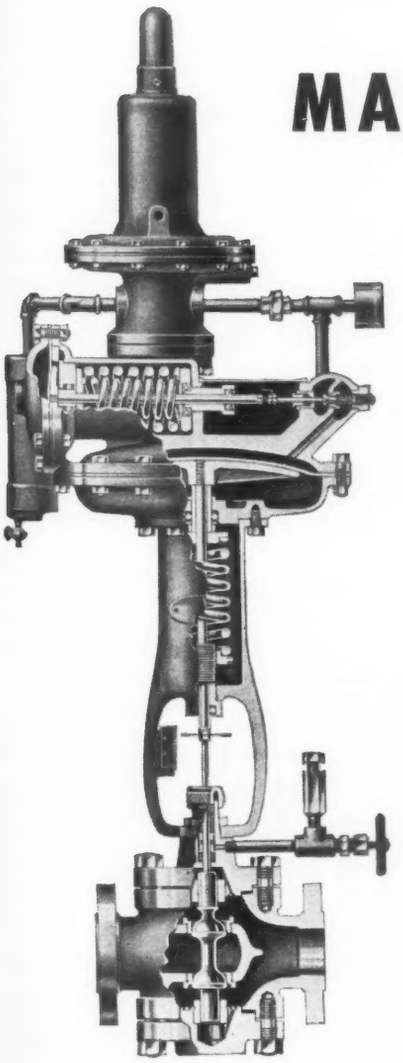
speed on this full-pressure lubricated engine is reduced to 525 rpm at pto by a 4-to-1 reduction gear.

Standard equipment for this engine includes stellite exhaust valves and seats, extra-large oil bath air cleaner, variable speed governor control and an over-center dry disc clutch. Gas-gasoline carburetion with secondary regulator permits operation on both gasoline or natural gas. An unusually large oil sump has the unique feature of a drain and fill plug on both sides.

(15) Thy-mo-trol Drive

A new low-cost Thy-mo-trol drive, known as the Type H1, has been announced by General Electric's control division. Furnished in ratings through ½ hp, the new drive utilizes a simplified half-wave circuit to provide d-c flexibility from a-c power. It is specially designed to provide, by the turn of a knob at a single control station, smooth stepless speed control on small lathes, grinders, drill presses, conveyors, pumps, packaging equipment, and paint and varnish mixers.





MASONEILAN REGULATORS

Guard Main Lines Against Excess Pressure

The Texas Gulf Coast installation shown above was laid out by our Gas Engineers to CONSERVE NATURAL GAS for our customer. This photograph shows only a small part of the gas system. MASONEILAN Regulators automatically control compressor suction pressure, as well as safeguard separators and other equipment from excessive pressures. MASONEILAN 2" No. 27 Reducing and No. 47 Back Pressure Regulators (at left) are used at key points in this system.

Your inquiry is invited

MAINTENANCE ENGINEERING CORPORATION

3611 CLINTON DRIVE
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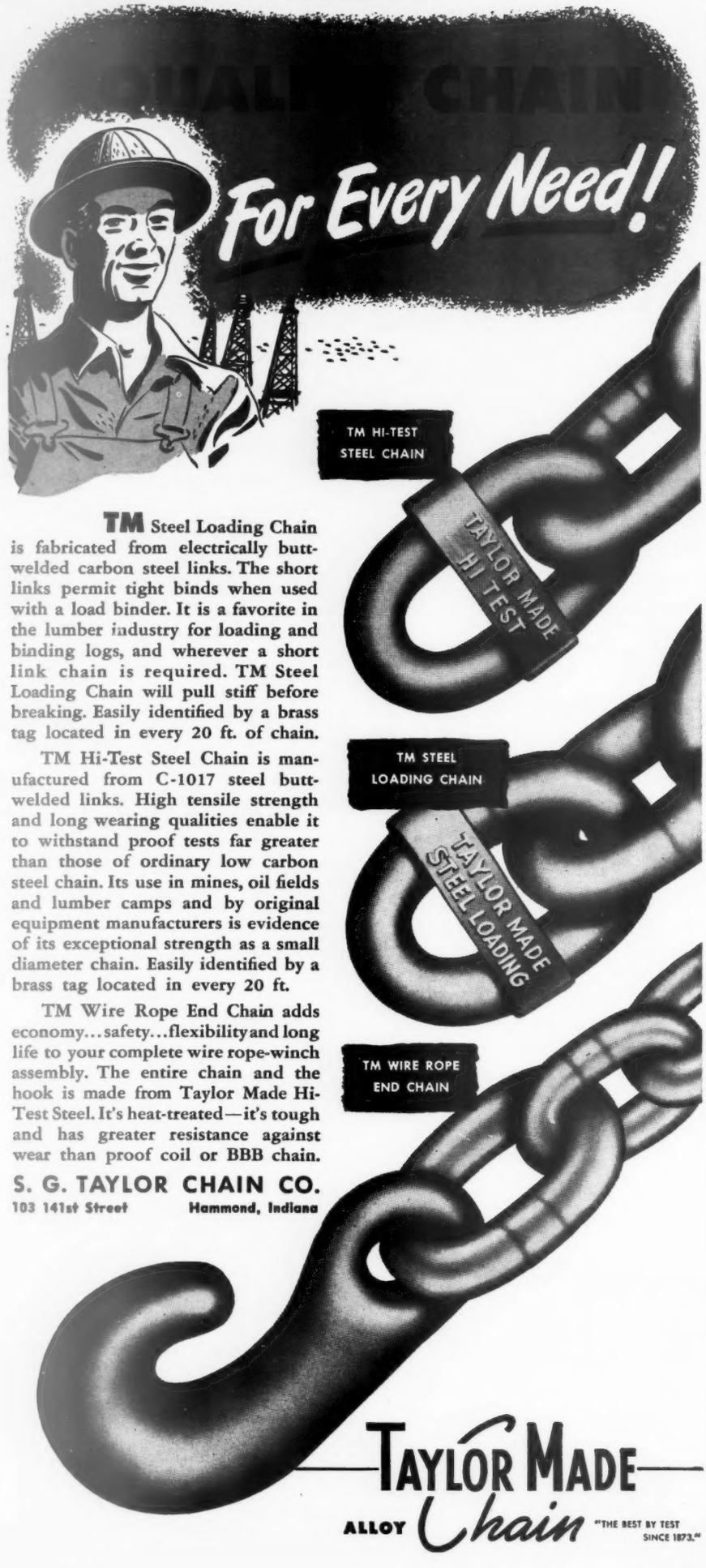
EQUIPMENT WITH ENGINEERING SERVICE

MECO



TM Steel Loading Chain is fabricated from electrically butt-welded carbon steel links. The short links permit tight binds when used with a load binder. It is a favorite in the lumber industry for loading and binding logs, and wherever a short link chain is required. TM Steel Loading Chain will pull stiff before breaking. Easily identified by a brass tag located in every 20 ft. of chain.

TM Hi-Test Steel Chain is manufactured from C-1017 steel butt-welded links. High tensile strength and long wearing qualities enable it to withstand proof tests far greater than those of ordinary low carbon steel chain. Its use in mines, oil fields and lumber camps and by original equipment manufacturers is evidence of its exceptional strength as a small diameter chain. Easily identified by a brass tag located in every 20 ft.

TM Wire Rope End Chain adds economy... safety... flexibility and long life to your complete wire rope-winch assembly. The entire chain and the hook is made from Taylor Made Hi-Test Steel. It's heat-treated—it's tough and has greater resistance against wear than proof coil or BBB chain.

S. G. TAYLOR CHAIN CO.
103 141st Street Hammond, Indiana

(16) Rigid Coupling

A new Taper-Lock rigid coupling for rigidly connecting the ends of two shafts has been announced by the Dodge Manufacturing Corporation of Mishawaka, Indiana. This new application of the Taper-Lock bushing first introduced for V-belt sheaves and later in the Taper-Lock flexible coupling is most important because this rigid coupling will take the place of the old type flange couplings in sizes up to and including $2\frac{15}{16}$-in. but will be furnished also in sizes up to and including 5-in. They will also replace the ribbed and compression couplings formerly furnished. The old type flange couplings will be continued in sizes from $3\frac{7}{16}$-in. up to 12-in.

(17) Cooler

The Igloo Manufacturing Company, Houston, Texas, announced the addition of a 10-gal corrugated cooler to their line of water cans for the oil industry. They now offer the can in the 3, 5 and 10 gal sizes. The coolers are manufactured from heavy galvanized steel of all welded and double lock seamed construction. They are completely insulated on sides, top and bottom.

(18) Power Slips

In order to assure greater personnel and equipment safety in drilling operation, The DeLaney Company has added two new features to their DeCo "Balanced" power slips. These improvements in no way affect the slips' simplicity of design. Seeing a need for more unity in power slip segments they have developed a feature called "Leveling Links" that provide a connection between each of the three slip segments. These power slips are so designed that they can be installed on "jacknife" rigs in the same manner as installed on "deep hole" power and steam rigs.

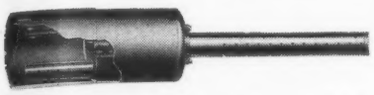
(19) Electric Hoist

Wright Hoist Division of American Chain and Cable Company, Inc., has announced another new series of Wright Speedway Electric Hoists. This new line of electric hoists is made in capacities from 1000 to 20,000 lb with an unusual degree of safety, efficiency, and ruggedness. The advance design incorporates all steel construction and gear train plus Trulay preformed cable and swaged on cable fittings.

Other construction features are ball bearing, fully enclosed NEMA motors, splined connections, grooved steel cable drum, jaw type brake, rabbeted male and female frame connections, push button controls, Hyatt roller bearings, safety limit stop, plus others.

(20) Terminal Exhaust Snubber

Development of a new terminal exhaust snubber has just been announced by Burgess-Manning Company, Libertyville, Illinois, for use on all four-



stroke cycle diesel and gas engines with relatively short exhaust systems in stationary and portable service and two-stroke cycle gas engine compressors operating on the Otto cycle in the petroleum field. Designated as series SDT, these units are available in pipe sizes from 5-in. to 14-in. inclusive.

The new terminal exhaust snubber combines the tail pipe with the exhaust snuber. It prevents noise by smoothing the flow of exhaust gas.

(21) Propulsion Equipment

Propulsion equipment for more than one third of the tankers now being built or contracted for in American shipyards will be supplied by the General Electric Company. Most of the 20 ships, representing nearly 350,000 gross tons of shipping, will be 12,500-hp "super-tankers."

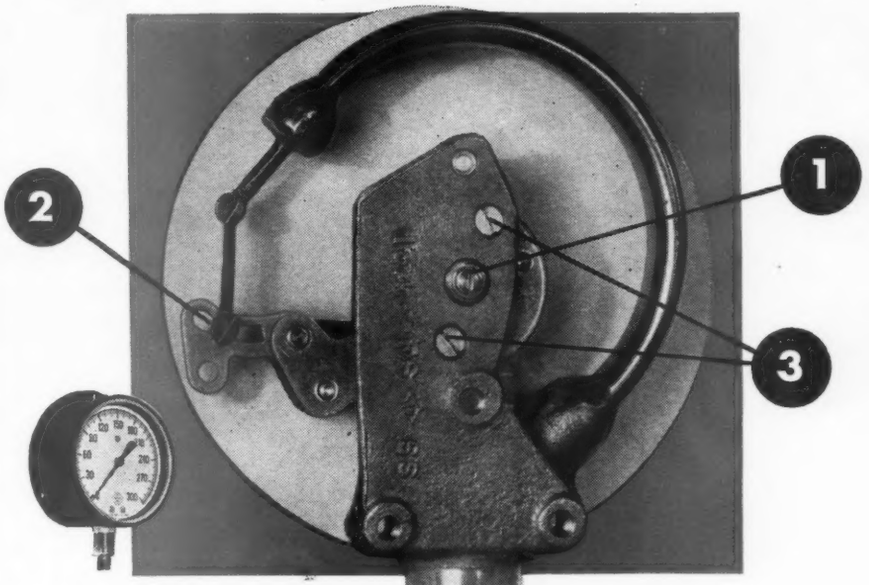
General Electric is supplying Newport News Shipbuilding and Dry Dock Company with double-reduction gears for six 26,000 deadweight ton vessels in addition to complete geared turbine propulsion drives for five other tankers of the same size. These ships will be capable of carrying 228,000 bbl of cargo oil at a cruising speed of 16 knots.

Sun Shipbuilding Company and Bethlehem Steel Company have also placed orders with GE. In addition, the company is supplying propulsion reduction gears, mechanical drive turbines, motors and switchboards for three 16,000-hp tankers being built by Welding Shipyards. Similar equipment for two other tankers of the same size has already been supplied to this yard.

(22) Vacuum Monitor

The greatly extended range and selective point vacuum control of the Skanascope vacuum monitors "Go-No Go" vacuum indicators and gages utilizing controlled gas-discharge tubes as their basic sensing element are announced by Skaneateles Manufacturing Company, Syracuse, New York. These monitors are uniformly sensitive to concentration changes, are extremely accurate for repetitive operations, require no recalibration and will hold a given vacuum value on dynamic systems within plus or minus one per cent.

The Easiest Gage to Calibrate!

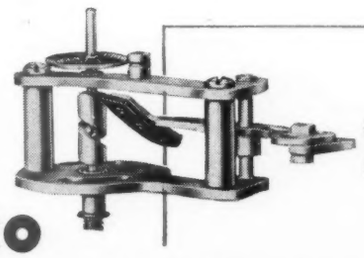


So says the Instrument Engineer

Here's Why: The external pointer set (1) is handy and very useful. In no other gage can the pointer be set without removing the glass and ring. Often a HELICOID gage can be made accurate simply by resetting the pointer.

If recalibration is necessary, the complete gage system is removed from the case. But there is no need to remove the pointer or dial. All adjustments are conveniently at the rear. For pointer travel, the link screw (2) is moved inward or outward in the cam slot. For scale linearity the movement is rotated by loosening screws (3). All this can be done *quickly* with a Helicoid gage. When recalibrating other gages, the pointer and dial must be removed frequently until calibration is attained. This takes more time and costs money.

The HELICOID gage is the easiest to calibrate and the easiest to keep in calibration.



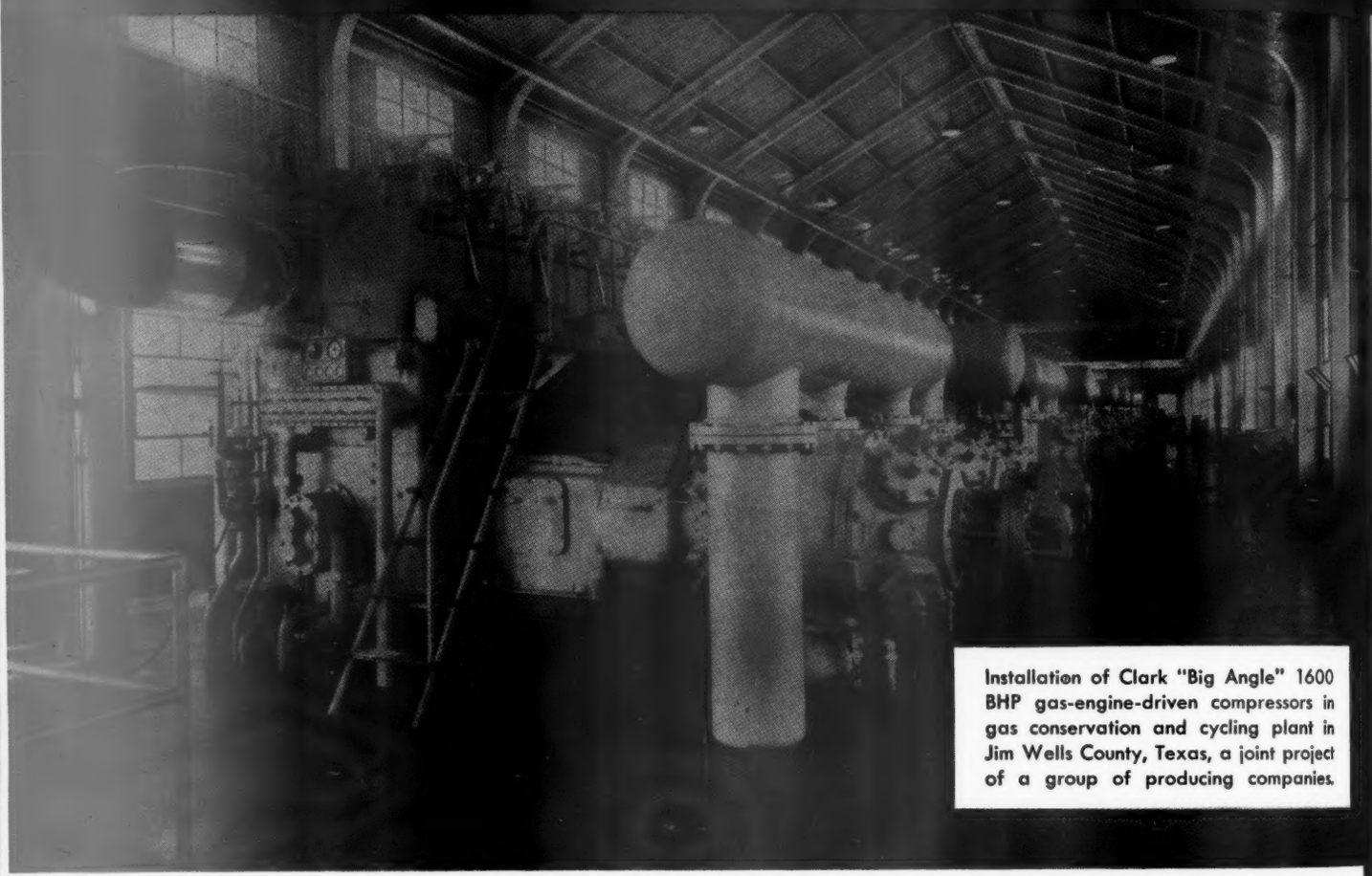
Only Helicoid Pressure Gages have the Helicoid Movement

ACCO

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
Bridgeport 2, Connecticut

TRADE MARK

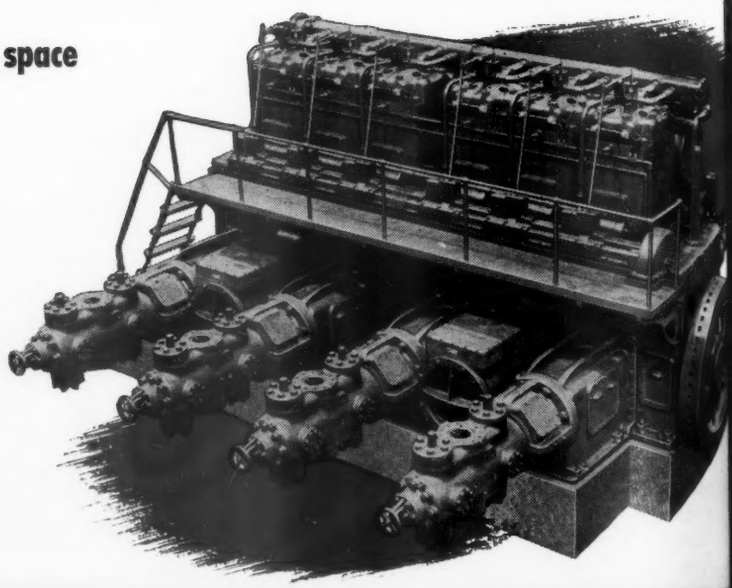
CLARK "BIG ANGLES" CO



Installation of Clark "Big Angle" 1600 BHP gas-engine-driven compressors in gas conservation and cycling plant in Jim Wells County, Texas, a joint project of a group of producing companies.

"BIG ANGLES" give you more power in less space

In addition to being the most compact, heavy-duty gas-engine-driven compressor unit ever built, the Clark "Big Angle" is the most accessible. A man standing on the platform can easily reach the air starting housings, camshaft, cylinder head, bolting, spark plugs, gas injection and starting plugs. Compressor cylinder covers are large and easy to get at. Packing is easily accessible. Compact design means minimum foundation and housing requirements and ease of installation. "Big Angles" save money in installation costs and maintenance.



Whatever type of Compressor you need, CLARK MAKES IT

CONSERVE GAS IN JOINT PROJECT near Premont, Texas

An outstanding example of joint operation of a gas conservation program is this plant on the Seeligson Ranch in Jim Wells County, Texas. Co-operating in this project are the following companies: Magnolia Petroleum, Ramsey Petroleum, Phillips Drilling, Renwar Oil, Republic Natural Gas, Shell Oil, Sinclair-Prairie Oil, Sun Oil, Sunray Oil and Texas Gulf Producing Company.

This fine, modern plant is equipped with eight Clark "Big Angle" 8 cylinder, 1600 BHP Compressors, with more units to be added. Residue gas is derived after extraction of natural gasoline and other products from casinghead gas produced with oil. The flare gas thus conserved is compressed in three stages up to 1000 psi and discharged into a pipe line for transmission.

Part of the ultimate plant will also be devoted to the manufacture of natural gasoline and allied products from high pressure gas, and the return of cycled gas to the sands at about 3000 psi.

This large scale conservation and cycling project shows what can be accomplished by a unitization plan through co-operation of the various companies who have an interest in a given field.

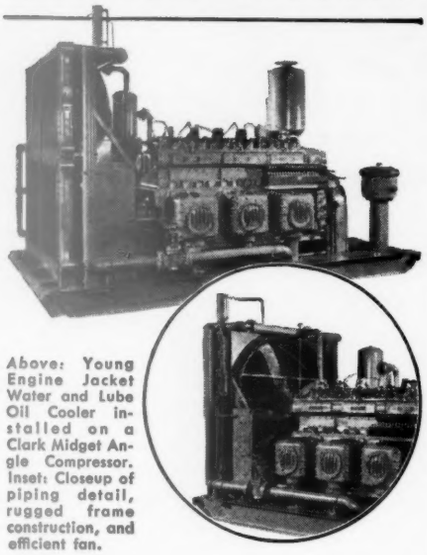
CLARK BROS. CO. INC., OLEAN, NEW YORK

BIRMINGHAM, ALA. • BOSTON • CHICAGO • DETROIT • HOUSTON • LOS ANGELES
NEW YORK • SALT LAKE CITY • SAN FRANCISCO • TULSA • WASHINGTON • LONDON
PARIS • BUCHAREST, RUMANIA • CARACAS, VENEZUELA • BUENOS AIRES, ARG.

For complete description and dimensional drawings, with other useful data, send for bulletin on the Clark "Big Angle".

CLARK "BIG ANGLES"

MULTIPLE COOLING FOR GAS COMPRESSORS



Above: Young Engine Jacket Water and Lube Oil Cooler installed on a Clark Midget Angle Compressor. Inset: Closeup of piping detail, rugged frame construction, and efficient fan.

● Portable gas compressors call for compact cooling units. Standard Young Jacket Water Coolers are the favorite heat transfer units in the field or at the refinery because they are specially developed for the equipment they serve. In addition to cooling jacket water and lube oil, Young Units are available for gas cooling between stages, making possible a complete, engineered cooling system from a single manufacturer.

Maintenance or repair service is never a problem with users of Young Oil Field Cooling Equipment. Young oil field distributors are easily accessible for service and replacement parts with branches at strategic points throughout the oil fields.

YOUNG Young Quality

HEAT TRANSFER PRODUCTS

AUTOMOTIVE PRODUCTS
Gas, gasoline, Diesel engine cooling radiators • Heat exchangers • Intercoolers • Oil coolers • Supercharger intercoolers

OIL FIELD, HEAVY INDUSTRIAL, MUNICIPAL & CHEMICAL PROCESS COOLING EQUIPMENT
Engine jacket water coolers • Oil coolers • Steam and natural gas condensers • Natural gas coolers • Evaporative coolers and condensers • "VAD" Vertical air discharge cooling and condensing units.

AERONAUTICAL PRODUCTS
Oil coolers • Supercharger intercoolers • Radiators • Heat exchangers • Valves • Regenerators

HEATING, COOLING AND AIR CONDITIONING PRODUCTS
Convectors • Unit heaters • Heating coils • Cooling coils • Air conditioning units • Evaporative condensers

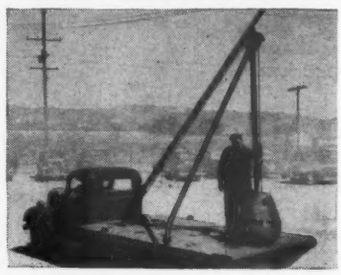
YOUNG RADIATOR CO.

General Offices: Dept. 219-B, Racine Wisconsin
Plants at Racine, Wisconsin, and Mattoon, Illinois

OIL FIELD DISTRIBUTORS
Mid-Continent Area: The Happy Company, 310 E. 10th St., Tulsa 1, Oklahoma. West Coast Area: A. R. Flournoy Co., 5043 Santa Fe Ave., Los Angeles 11, Calif. Michigan Area: H. J. Young, 1364 Lake Shore Drive, Muskegon, Michigan.

(23) "A" Frame

Designed to provide a safe, efficient means of hoisting loads on or off any flat bed truck, the Blackman E-Z one-



man "A" frame can be operated by only one man throughout the full procedure of picking up, loading, transporting and unloading. It requires no more rig-up or tear-down time than regular chain-held masts.

(24) Heater Shutters

Kysor Heater Company of Cadillac, Michigan, announces an automatic radiator shutter for stationary engines temperature control. They are designed for each application to give positive close range, 7 to 10 deg, temperature control.

(25) Multiple Oil Purifier

The world's largest multiple refill-type oil purifier, employing 7 filtering units, is in current production at Honan-Crane Corporation, a subsidiary of Houdaille-Hershey, Lebanon, Indiana. The maximum capacity of this unit exceeds 2100 gph of 50 sec viscosity color clear oil on continuous circulation.

(26) Trenching Machine

The Everett Manufacturing Company, Inc., Phoenix, Arizona, has placed the national distribution of the new Everett Trencher with The Tractor Sales Corporation, Los Angeles, California.

They claim that this new trenching machine will equal the pick and shovel work of twenty-five men and that it is expressly suited for digging housing project foundations; irrigation lines; water, gas, electric and sewer lines, for farm irrigation and kindred work.

This new trencher has adjustable clearance teeth and digs from 12 in. to 18 in. in width. It can be set to cut any distance down to 42 in. deep, and it travels from 1½ to 5 ft a min.

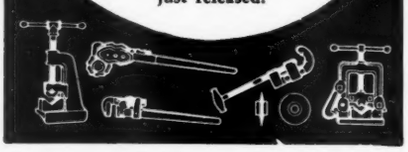
CHAIN TONGS

"ARMSTRONG BROS." Chain Tongs come in "Standard," "Reversible Jaw" and "Ideal" (V-jaw) types—in sizes for every need. Their drop-forged jaws have milled teeth, are hardened, tempered and tested for wearing qualities. They have heavy forged-in lugs that give extra bearing on the handles to which they are rigidly held by a large hardened steel bolt. The handles are forged and heat treated to the correct balance of stiffness and spring. Shackles are drop forged and chains proof-tested to ⅜ catalog strength (5,600 lbs. to 40,000 lbs.).

STOCKED BY LEADING TOOL DISTRIBUTORS

ARMSTRONG BROS. TOOL CO.
5231 West Armstrong Avenue
Chicago 30, U.S.A.
New York
San Francisco

Write for NEW S-48 Catalog just released.



Campbell's Feet

GAUGE STRIPS

For float indicators or Tubular Gage Glass

Specially die-cast close-grained metal. Copper and molybdenum plated.

Clear reading with raised numerals and graduations. Accurate to .001 inch. Corrosion-proof. Last a lifetime.

Numerals read up or down, as desired, in feet, either decimal scale to 0.01 feet or inches to ⅛".

Furnished complete with numerals, mounting screws, ready to install. Numerals available up to 40 feet.

Write for Descriptive Bulletin

Manufactured and distributed by

J. A. Campbell Co.

645 E. Wardlow Rd., Long Beach 7, Calif.

(27) Micro-Feeder

A new precision machine for laboratory operations such as the injection of additives into pressure autoclaves has been announced by Proportioneers, Inc., Providence, Rhode Island. The Micro-Feeder is designed to inject a smooth, uninterrupted flow through a capillary tube and injection needle. Capacity of standard unit is 100 cc with feeding rates as low as 1 cc per hr. Either change gears or variable speed drives are available to provide constant rate or flow proportional feeding. A synchronous 110V ac motor drives the unit and is automatically stopped when limit of plunger travel is reached. Signal light and four-figure totalizer are included. Extreme accuracy of addition is assured by the 100 per cent volumetric efficiency of the Micro-Feeder.

(28) Jig Boring Machine

A Swiss precision jig boring machine combining the highest accuracy with exceptional output capacity has been made available by Hauser Machine Tool Corporation, Manhasset, New York, U. S. factory representative of Henri Hauser, Ltd., Bienne, Switzerland.

A particularly noteworthy feature of the Hauser 2BA is the completely centralized control. From the operating position in front of the machine all controls are within convenient reach. Micrometer screws are made of special steel and hardened, and high-precision ground. The microscope has three-point suspension and is independent of the rotating part of the spindle. Capacity is 14 in. by 8 in., readings .0001 in. and accuracy of slide locations .00015 in.

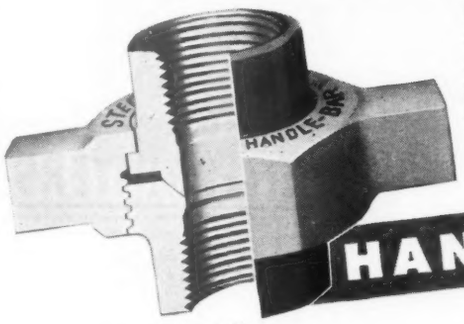
(29) Metering Mud Mixer

One of the more recent contributions to the reduction in oil well drilling costs is the Empire "Metering" Mud Mixer, now being built and distributed by the Empire Machinery Company, Ltd., of Odessa, Texas.

The Empire "Metering" mud mixer departs from conventional mixer design in that it meters the flow of dry chemical mud prior to its combination with wet mixture. Mixing takes place in a specially-engineered selective jet nipple chamber, available in any inside diameter from ½ in. to 1½ in. As the sacked mud pours into this chamber, it is accurately measured out through an adjustable patented "Metering Hole." Efficient mixing obtained by pump pressure in the jet nipple chamber keeps the dry and wet mud positively united in the mud pit. The Empire "Metering" Mud Mixer produces a bottom hole lubricant that is cohesive and uniform in viscosity.

FIRST CHOICE IN FORGED STEEL UNIONS

For over 35 years these Unions have given consistent and dependable service in the Oil and Gas industries. Universal acceptance and present demand, which is now greater than ever, make them the number one Unions.



HANDLE-BAR

Sizes ⅜" to 4"

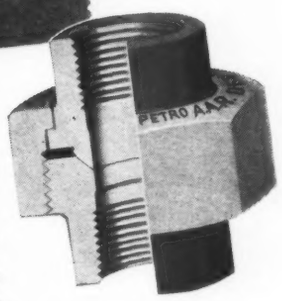
These easy to handle Hi-Speed Handle-Bar Unions have integral steel to steel seats, or completely fused bronze to bronze seats. The nut threads are modified Acme to facilitate easy and speedy assembly and disassembly. The seat design is a 45 degree cone, machined and cold rolled, to a ball seat on the male end. Furnished in black hub ends with Udylited nut, or all rustproof with Udylited hub ends and Parkerized nut.

4000 Test Unions sizes ⅜" to 4" inclusive are furnished with Briggs Standard steam threads in pipe ends.

6000 Test Unions sizes 2" to 4" inclusive have long pipe ends with A.P.I. line pipe threads.

HANDLE-BAR Unions are recommended for all services. Use a hammer instead of a wrench to tighten or loosen the nut.

PETRO

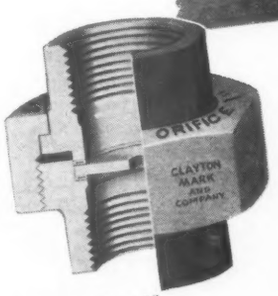


This Union has features that make it the most universally used Union. It is made to A.A.R. standards with integral steel to steel seats. The seat design is a 45 degree cone, machined and cold rolled, to a ball seat on the male end. The ends and nut are extra heavy and the nut threads are permanently lubricated and rustproofed with Udylite Cadmium.

A partial list of PETRO'S proven services include pressures from a vacuum to 3000 lbs.; Temperatures from 100° below zero, F., to 1000° above zero F.; on Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and all other services in which Steel or Wrought Iron Pipe is used.

Sizes ⅛" to 3"

ORIFICE



Sizes ¼" to 3"

"ORIFICE" Unions, screwed, or socket weld are widely used for flow control of Steam, Oil, Ammonia, Chemicals, Water, Gas and Air. Also for metering and measuring. The ORIFICE is recommended for working pressures of 600 lbs. at 900° F., or 2000 lbs. at 150° F. Furnished with 18-8 stainless steel orifice plate and steel jacketed asbestos filled gaskets. These are set in a groove of solid steel to facilitate ease of tightening and to safeguard against possible blowing of the gaskets and resultant trouble.

The nut threads are Cadmium plated (UDYLITED) for permanent thread lubrication.

Order by Trade Name from Your Local Jobber

ORIGINATORS AND PIONEERS OF STEEL UNIONS SINCE 1912

CLAYTON MARK & COMPANY

1900 DEMPSTER STREET • EVANSTON, ILLINOIS

For those who want better prints

faster

Model 21 Bruning Whiteprinter for moderate print production.

BRUNING BW WHITEPRINTERS

There is a Bruning Whiteprinter to meet the requirements of any drafting or engineering department . . . and every one of them is designed to make perfect prints of your tracings . . . fast. In seconds after you turn on a Bruning machine you are producing copies that are tops in legibility. There is no time lost waiting for prints to dry . . . BW prints are ready for instant use as fast as they come from the machine. There is no time spent making negatives . . . BW machines make clear, sharp positive prints (black on white) directly from any copy that is drawn, typed or printed on a translucent material.

If you need sharp duplicate prints . . . big or small . . . on paper, card, film, or cloth, it will pay you to investigate Bruning Whiteprinters . . . the last word in efficient and accurate duplication of engineering and/or office forms.

CHECK THESE BW ADVANTAGES

Just plug in: Bruning Whiteprinters plug into standard 110 or 220 outlets, depending upon the size of the machine. No special wiring required.

No vents or exhaust fans: The BW process is completely odorless . . . can be performed anywhere in the office without the slightest offense.

No plumbing connections: There are no pipes to connect, no water to supply or drain away. Nothing to anchor the machine to one spot.

Wide variety of prints: BW prints can be made on light, medium or card weight paper with black, blue, red or brown lines. Also on tinted stocks, transparent paper, film and cloth.

A 1001 uses: A BW unit can reproduce a letter, invoice, chart, financial report or other document as easily and quickly as it makes perfect prints from engineering drawings. It is truly a company-wide machine.

Other Bruning products you should know about

Drafting Machines - Drafting Room Furniture - Slide Rules - Erasing Machines - Surveying Instruments Tracing Papers and many others.

Send today **for full information.**

Let us send you a file of descriptive literature on Bruning Whiteprinters and BW materials. There is no obligation. It would be helpful to know approximately how many copies you plan to make a day and their average size.

Charles Bruning Company, Inc.

Since 1897

4712–38 West Montrose Avenue, Chicago 41, Ill.

New York - Chicago - Los Angeles - And 11 Other Cities

(30) Mud Mixing Unit

The "Mudmaster," new Texas Iron Works mud mixing unit, conditions mud in the least possible amount of time. Sack material is fed into the hopper at the top of the unit and is conveyed through the mixing tube by a screw conveyor. A propeller on the lower end of the conveyor shaft, inside of the duct, stirs the fluid mixture while vanes on the shaft break up the weighting materials, clay and chemicals being fed. A 10 hp steam turbine, electric motor or internal combustion engine furnishes power for the mixer.

(31) Portable Electric Drill

A heavy duty portable electric drill, designed to stand up to full industrial loading and the toughest metals, has just been made available for the first time, by S. Wolf and Company, Ltd., London, England. U. S. representative, Fred L. Stuart, New York 18, New York.

This rugged English drill (NW3C) is built to stand up under continuous operation in heavy production work requiring precision standards. With its accessories which include a bench drill stand and a bench clamp stand, it serves as a drill press and as a bench grinder. Cellulose polishing accessories are offered.

Steel drilling capacity $\frac{3}{8}$ in.—wood $\frac{5}{8}$ in. Spindle speed running light 750 rpm—on full load 450 rpm.

(32) Conveyor

A continuous, automatic materials transport, the Houdaille conveyor will move any material which will settle to the bottom of a tank, hopper, bin or other form of reservoir. The conveyor consists of a series of neoprene or cast iron flights, assembled on an endless chain. The chain and flights are pulled through a pipe casing by means of a high torque gear transmission. The casing, custom-bent to the specifications of the origin and delivery points is of 2, 4 or 6-in. diam (other sizes are available when needed). Savings of 50 to 90 per cent of labor costs in materials handling have been reported.

(33) O. Z. Bushings

The O. Z. Electrical Manufacturing Company, Brooklyn, New York, is now offering a new all Bakelite insulating bushing of increased strength and durability.

Tests conducted by an independent laboratory showed the new line of bushings to be superior to competitive bushings tested. Rounded edges protect wire insulation during pulling and when in service. Clean, deep threads and ribbed outer surface make for easy, fast installation.

(34) Duplex Pumps

Two new duplex reciprocating pump series are announced by Frank Wheatley Pump and Valve Manufacturers.

Called the "Economy Special," the Wheatley 1800 series is designed to do the work of more expensive pumps with no sacrifice of efficiency or durability. These pumps come in sizes from 2½-in. to 4-in. by 6-in. They are V-belt driven and can pump 162 bbl per hr at 350 psi, running at 90 rpm.

This new pump line will be particularly adapted to partially abandoned properties where only one or two wells are still pumping. Centralized pumping stations can be dismantled and individual 1800 series pumps placed on the still-producing wells.

The other new Wheatley line, featuring round valve pots for higher pressures and volumes, is the series 6000. This line comes in 2¼-in. to 5-in. by 10-in. and 4-in. to 7-in. by 10-in. sizes, V-belt driven. With semi-steel fluid end, 1920 pounds working pressure is possible, using 2⅜-in. liners.

(35) Electronic Transmitter

Transmission of pressure indications is now provided by means of a new microsen pressure transmitter, manufactured by Manning, Maxwell and Moore, Inc., Bridgeport, Connecticut. Pressure motion is picked up from the tip of a Bourdon Tube and by means of the microsen electro mechanical relay, this motion is converted into a stable and accurate dc signal which can be indicated or recorded with milliampere or millivolt instruments.

(36) Ultra Violet Lamp

Announcement was made recently of the new Mineralight Model H ultra violet lamp by Ultra Violet Products, Inc. of Los Angeles, California. Many types of professions are reported to be using model H mineralight for fluorescent analysis. Petroleum engineers have found Model H to be a quick means of identifying core samples. Unit operates on 110 volt ac from standard electrical plug-in connections.

(37) Drip-Proof Motors

Wagner Electric Corporation, which has built drip-proof motors in frames 225 and smaller for many years, has adopted the same design for its polyphase motors in the 254, 284, 324 and 326 frames. The motor frames of the new design are almost exactly like those of their prototypes which have proved themselves so well, differing from them only in the omission of all ventilating openings.

FOR DEPENDABLE LIQUEFIED GAS SERVICE...

Specify LUNKENHEIMER N-M-D VALVES

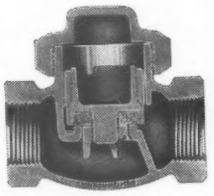


Fig. 402
Lift Check

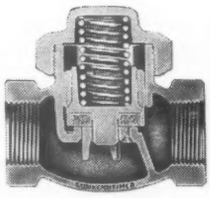
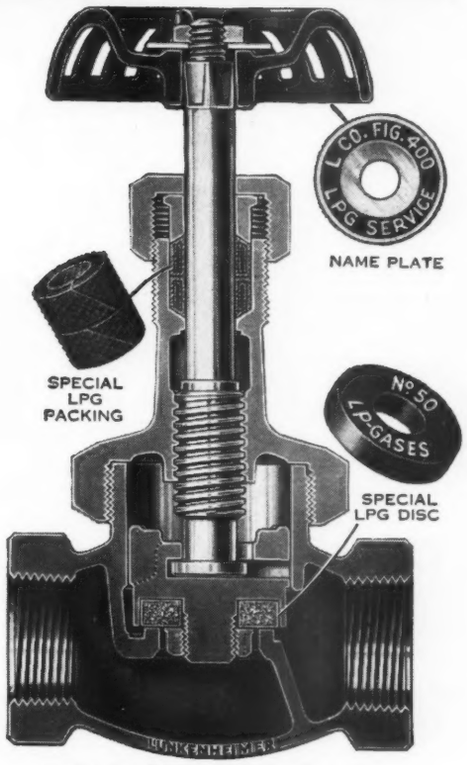


Fig. 403
Lift Check with Spring



400 lb. W.O.G.

For Liquefied Petroleum Gases... in LP-Gas systems, bulk transfer and storage tanks, domestic cylinder charging manifolds, vapor differential compressors and the many industrial uses... Lunkenheimer 400-lb W.O.G. (Water-Oil-Gas) Globe, Angle and Check Valves meet every need.

Designed for this particular service and reflecting Lunkenheimer Quality throughout, these rugged valves have special packing and a special, easily renewable non-metallic disc. They seat tight and stay tight. These valves are approved by Underwriters' Laboratories, Inc., for Liquefied Petroleum Gases.

Write for Circular 576, or ask your Lunkenheimer Distributor for a demonstration of Fig. 400 "N-M-D" Valves for Liquefied Petroleum Gases. Lunkenheimer Distributors are located in oil producing and refining centers.

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THE LUNKENHEIMER CO.
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LUNKENHEIMER VALVES
BRONZE, IRON, STEEL, AND CORROSION RESISTANT ALLOY VALVES
AIR DEVICES, LUBRICATORS, AIRCRAFT FITTINGS

trade literature

PUBLICATIONS LISTED ARE SENT FREE UPON REQUEST

(38) Control Devices

Allis-Chalmers' line of switchgear and control devices is covered in a new 16-page guide released by the company.

Described and illustrated are rotary control switches, push button stations, generator voltage regulators, synchro-operators, current and potential transformers, oil and air circuit breakers, disconnect switches, oil immersed contactors, d-c relays and contactors, thermal relays, d-c remote positioning devices, indicating lamps, resistors, and terminal boards.

(39) Temperature Control

Tempil° Corporation publishes a bulletin of tips and techniques in temperature control. The most recent bulletin summarizes the basic metallurgical data on "Copper and Its Alloys."

(40) Clearing Methods

The Caterpillar Tractor Company has published a new booklet "Clearing for Action." This publication features clearing methods for reclaiming productive agricultural land, construction sites, mine and quarry operations, housing projects, and applications in the export field.

(41) Cooling Towers

The Marley Company, Inc., has prepared a series of question-and-answer type monthly mail pieces entitled "What's Your Cooling Tower I. Q.?"

The first of the series deals with water distribution; the second, air movement; the third, facts and figures, and so forth. The subject is technical and informative, but presentation is informal.

(42) Pressure and Vacuum Gauges

The Brown Instrument Company, a division of Minneapolis-Honeywell Regulator Company, offers a booklet on pressure and vacuum gauges. This literature shows the pressure measuring systems designed for optimum performance in a particular pressure or vacuum range.

(43) Petroleum Analysis

Merrill, Lynch, Pierce, Fenner and Beane analyze the activities and earnings of the oil industry, in their latest report on a major industry. In this booklet, the 1948 oil picture is painted with reference to: The investor, cause of the present boom, reserves, exploration, and refining. Summaries of the activities of 36 oil companies are included with average balance sheets.

(44) Forgings

A reference data booklet on the subject of forgings is a catalog published by the Steel Improvement and Forge Company. It decribes the various types and characteristics of forgings, and discusses considerations in designing for forgings. Tables present information on the characteristics and applications of commercial forging metals, including carbon and alloy steels, corrosion resisting steels and high temperature alloys. Illustrative material shows typical grain flows, steps in forging process, and a wide variety of forgings with holes, pockets, recesses, ribs and thin sections.

(45) Pneumatic Transmission

Republic Flow Meters Company has announced a booklet on pneumatic transmission. Flow, liquid level, pressure, or liquid density, are converted into air pressures which vary proportionately with the process variables. Construction features and operating principles of the pressure transmitters are given with other pertinent data.

(46) Catalytic Cracking

The M. W. Kellogg Company has published a chronological, photographic listing of the 42 Kellogg cat-crackers on stream and on the way. The oil companies operating the units are given along with the refinery locations. The capacity bbl per day from 1942 through those on order is illustrated.

(47) Double Seal

Spang-Chalfant, division of The National Supply Company, has published a booklet on the double seal shrink thread drill pipe and tool joints. The shrink thread connection is now offered with two seal areas, one internal and one external. This reduces drill pipe failure, prevents shut downs, and increases drilling profits.

(48) Pipe Joint Protection

The Tapecoat Company offers a new bulletin on protection for steel pipe joints and service connections. This literature presents a photographic description showing the application of this tape-type protection which is widely used for welded field joints, street and house service connections, river crossings, pipe under streets and through walls.

(49) Heat Exchanger

Engineers who have difficulty with heat exchangers that become clogged from dirty or corrosive fluids will be interested in a new bulletin describing the Type CW tubeflo section which has been published by The Griscom-Russell Company.

The bulletin explains the exclusive design by which heavy viscous or sediment-bearing liquids are carried completely through this unit without fouling.

(50) Plug Valves

Recently published by American Car and Foundry Company is a catalog on plug valves for gasoline, oil, water, air, gas, vacuum, acids, caustic solutions, chemicals, and other fluids. Various type valves of different weights are illustrated and dimension charts are listed for each.

(51) Flange Dimensions

A 20-page illustrated booklet of flange dimensions based on API standard 6B has recently been published by Oil Center Tool Company, Houston, Texas.

(52) Pump and Heater Sets

Peabody Engineering Corporation has published a bulletin on the complete line of Duplex pump and heater sets. Complete with diagramatic layouts and photos, this bulletin also shows the various elements and factors that must be considered in ordering for specified purposes and applications.

(53) Lighting Lines

Mines Equipment Company has just issued two color bulletins on Spring-a-lite which introduce Mines Equipments revised lighting lines for the four API oil derrick heights. Res808 covers the vapor-proof and Res809 the weatherproof assemblies. Individual outlet circuit breaker protection is provided by power distribution boxes.

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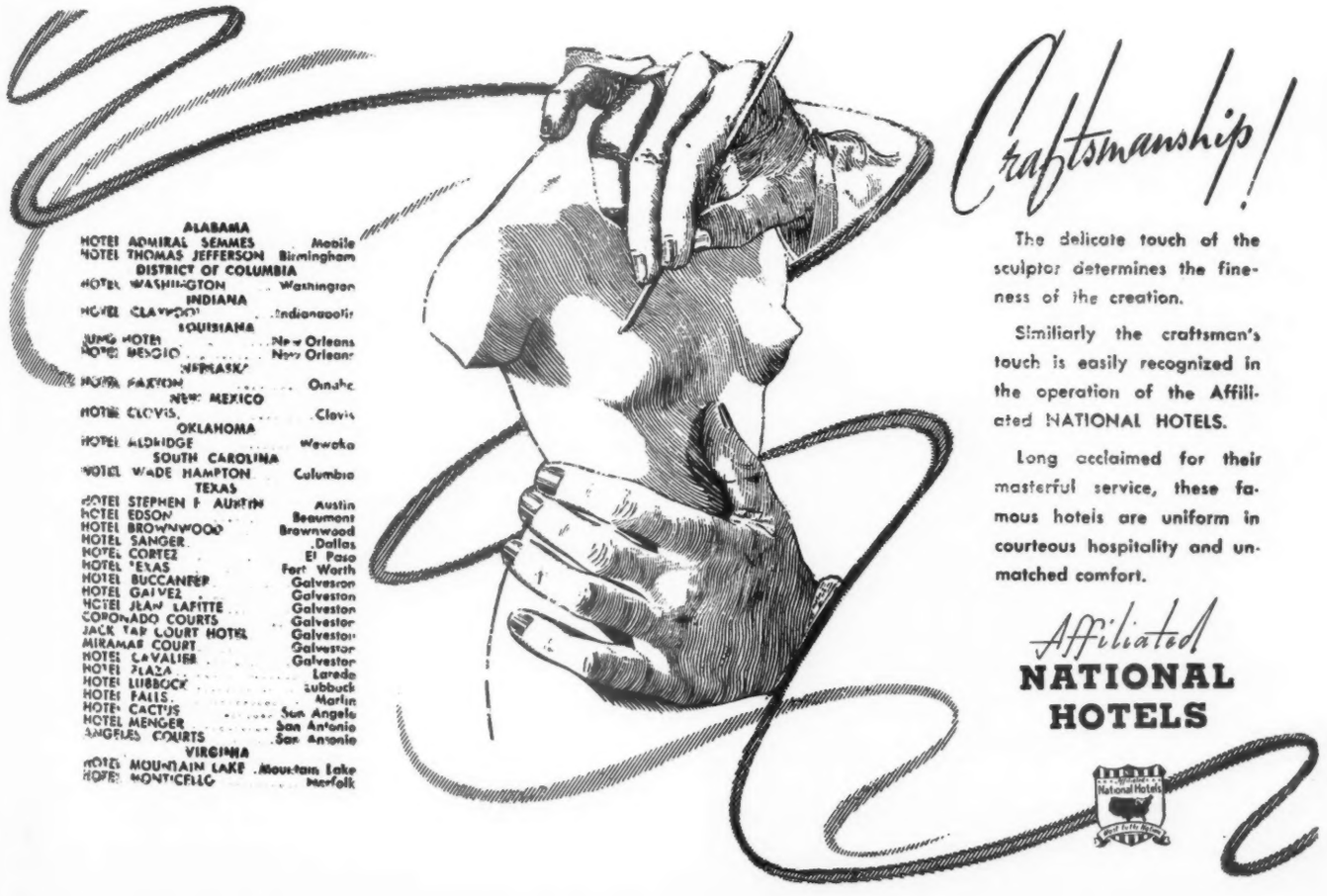

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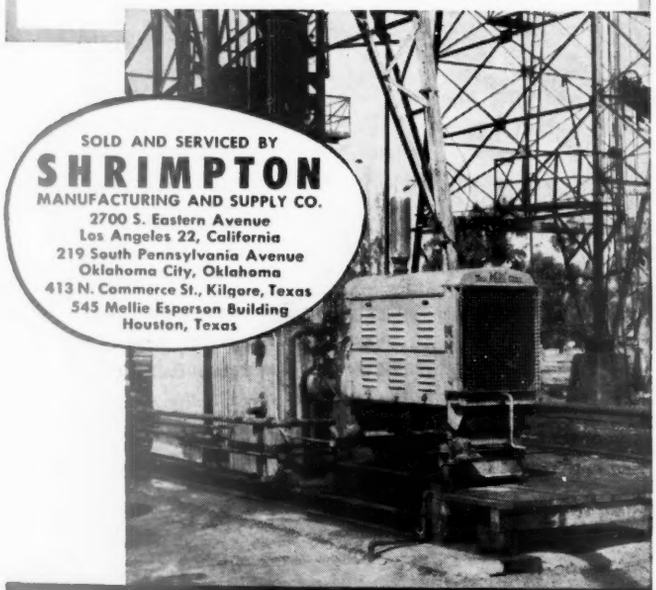

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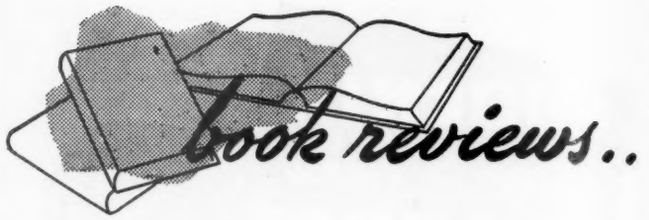

▸ **Early Days of Oil,** *by Paul H. Giddens. Princeton University Press, Princeton, New Jersey. Pages, 150. Price, $6.*

From the priceless collection of 3000 John A. Mather photographs preserved in the Drake Museum, Paul Giddens, curator, has chosen 365 pictures to present this history. Pictorially recorded here is the development of the oil industry from 1860 through 1892. Boom towns and disasters, early wells, primitive equipment, transportation, and outstanding characters of the era were all photographed by Mather as he followed the excitement of the infant industry. Of special interest to oil men, *Early Days of Oil* will appeal to everyone interested in a colorful era of American history.

▸ **Abstracts of Papers, American Chemical Society, 114th Meeting.** *1155 Sixteenth Street N.W., Washington 6, D. C. Pages, 123. Price, $2.*

Seventeen divisions of chemistry are represented in this book, with one to three papers for each listing. The abstracts are prepared by the authors, who are indexed. Among the chemical subjects treated are: Analytical and micro, biological, colloid, fertilizer, gas and fuel, industrial and engineering, organic, paint, varnish and plastics, and petroleum.

▸ **Drilling and Production Practice, 1947.** *American Petroleum Institute, 50 West 50th Street, New York 20. Pages, 321. Price, $5.*

Selected papers presented here are in four sections, covering drilling practice, production practice and technology, materials and miscellaneous. In addition, the volume contains a bibliography of abstracts of all papers presented at API district meetings in 1947.

Subjects covered include: Drilling practice; drilling muds, and diamond coring: Production practice and technology; unconsolidated sands, dual completions, MER, imput wells, and logging techniques: Materials and miscellaneous; casing standards and design, pressure-volume-temperature correlation, and secondary recovery.

▸ **Conversion of Petroleum,** *by A. N. Sachanen. Second edition. Reinhold Publishing Corporation, 330 West 42nd Street, New York. Pages, 602. Price, $11.*

This volume is devoted to the production of motor fuels by thermal and catalytic processes, and is a thoroughly revised and partially rewritten version of the first edition. The first book related the fundamental principles and practices of converting petroleum products into gasoline and other fuels. Only the most important works, from the author's point of view, have been referred to and discussed.

▸ **Oil and Gas Field Development in the United States,** *Year Book 1948, Vol. XVIII. National Oil Scouts and Landmen's Association, Austin, Texas. Pages, 897. Price, $8.50*

Forty of the 48 states are covered in this annual review of geological and geophysical prospecting, land and leasing activities, wildcat exploration, proven field development, oil and gas production, pipe line and refinery statistics.

Editor-in-Chief this year is P. Wayne Ferguson of Shell Oil Company. Outstanding men in each state have reported on the situation in their district, tables and maps give a clear picture of progress made in each state during 1947.